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MECHANICAL PROPERTIES OF 2618 ALUMINUM ALLOY

J. A. LUMM

NORTH AMERICAN AVIATION, INC.

TECHNICAL REPORT AFML-TR-66-238

July 1966

Air Force Materials Laboratory
Research and Technology Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

MECHANICAL PROPERTIES OF 2618 ALUMINUM ALLOY

J. A. Lumm

FOREWORD

The work presented in this report was performed by the Columbus Division of North American Aviation, Inc., Columbus, Ohio, under Contract Number AF 33(615)-3259. The contract was initiated under Project No. 7381, "Materials Application", Task No. 738106, "Design Information". The work was administered by the Air Force Materials Laboratory, Research and Technology Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, under the technical direction of Mr. Marvin Knight.

The investigation was carried out under the supervision of Mr. J. A. Lumm. Acknowledgement is given to Mr. R. A. Wallace who performed all of the fatigue, creep, and fracture toughness tests, to Messrs. J. Spino, P. A. Anderson and E. W. Heinemann who performed most of the static tests, and finally to Messrs. D. M. Rosenbaum who originally conceived the program, and R. J. Shelton who performed the arduous task of laying out and sectioning the billets.

This is a final report and covers the work performed during the period 1 October 1965 through 30 June 1966. The manuscript was released by the author in July, 1966 for publication as an RTD Technical Report. The North American Aviation, Inc. internal number for this report is NA66H-23-3.

This technical report has been reviewed and is approved.

D. A. Shinn
Chief, Materials Information Branch
Materials Application Division
Air Force Materials Laboratory

ABSTRACT

Mechanical property tests were conducted over the temperature range from room temperature to 400°F on three sizes of hand forged 2618 aluminum alloy billet produced by two suppliers. Tension, notched tension, tension thermal stability, compression, shear, bearing, fracture toughness, creep, axial and rotating beam fatigue, and stress corrosion properties were determined. Tension, compression, shear and bearing properties were statistically analyzed to determine values similar to "A" and "B" design values found in MIL-HDBK-5.

Alloy 2618-T61 retains its static and fatigue properties well at elevated temperatures and has good resistance to creep deformation. At 400°F 2618 retains approximately 80% of its room temperature properties after short time exposure. Applied stresses exceeding the yield strength are required for appreciable creep to occur at 250°F, while stresses of approximately 75 and 50 percent of the yield strength at temperature are required for 1% creep to occur in 1000 hours at 325°F and 400°F. Plane strain fracture toughness at all areas in the billet in the longitudinal direction and at the mid-thickness area in the long transverse direction was similar to 7075-T6; however, the quarter-thickness and surface areas of the billet in the long transverse direction generally had lower fracture toughness than most data reported for 7075-T6. Stress corrosion tests indicated that 2618 is susceptible to stress corrosion cracking in the two transverse directions when stressed to 75% of its yield strength.

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SECTION I

INTRODUCTION

With the increased performance and temperature requirements of present and future aerospace systems, usage of many aluminum alloys as load carrying structural members will be limited because of the drastic decrease in mechanical properties which many of the high strength alloys experience with exposure to temperatures of 300°F and above.

Aluminum alloy 2618 was developed specifically for elevated temperature use and exhibits excellent mechanical property retention at elevated temperatures in the range of 300°F to 400°F compared to most of the high strength alloys such as 7075-T6 and 2014-T6. This alloy has not, however, been used in the United States to any great extent for structural applications. It was felt that one reason for this limited usage was the lack of user experience and of valid design data.

In 1960 North American Aviation, Inc., Columbus Division, initiated a study program to establish design values for 2618-T61 aluminum alloy hand forged billet for a specific application in a high performance aircraft. However, after approximately 50% of the study was completed an alternate approach was taken and the program was not finished. Since the existing data published in MIL-HDBK-5 on 2618 are for tension only and based on supplier specification minimums, it appeared that there was a definite need for additional data on this material. Consequently the Air Force Materials Laboratory provided funding to complete the evaluation program initiated by North American Aviation, Inc.

The purpose of this study program was to evaluate three sizes of forged 2618 billet produced by two suppliers in the temperature range of room temperature to 400°F. Tensile, notched tensile, tensile thermal stability, compression, shear, bearing, unnotched and notched axial tension and rotating beam fatigue, creep, fracture toughness and stress corrosion studies were conducted. The tensile, compression, shear and bearing results were statistically analyzed to determine values similar to "A" and "B" design values found in MIL-HDBK-5.

SECTION II

EXPERIMENTAL PROGRAM

Test Material

Three heats of 2618, hand forged billet, Federal Specification QQ-A-367, were evaluated, one heat from the Aluminum Company of America and two heats from Kaiser Aluminum. One heat of material from Alcoa and Kaiser (purchased in 1960) was supplied in the following sizes and heat-treat conditions:

(a) 3" x 6½", 2618-T61

(b) 4" x 3", 2618-F

(c) 8" x 11", 2618-F

The remaining heat from Kaiser was recently purchased and was supplied in the following condition:

(d) 4" x 8", 2618-T61

Heat-treatment of billets (b) and (c) was performed at the North American Aviation, Inc., Columbus Division, facility and was accomplished by solution treating to the T41 condition by heating to 985°F ±10°F for eight hours and quenching in boiling water. Aging to the T61 condition consisted of heating at 390°F ±5°F for twenty-four hours and air cooling. Billet (c) was sectioned to a maximum four inch thickness prior to heat-treatment to comply with QQ-A-367. Heat-treatment was in accordance with NAA Specification LA0111-001 (MIL-H-6088).

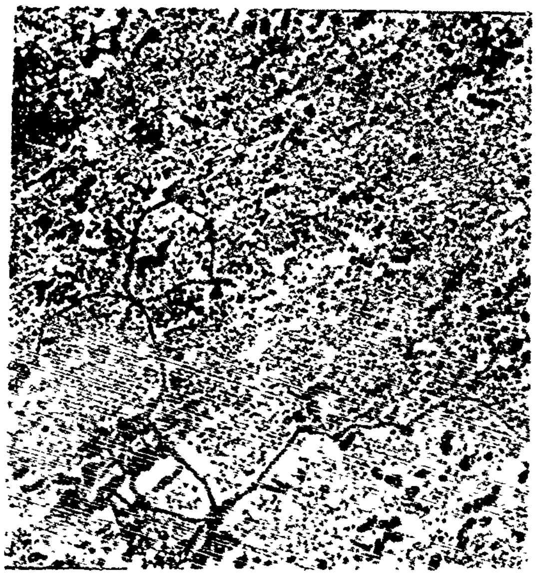
Nominal chemical composition limits of 2618 are shown in Table I.

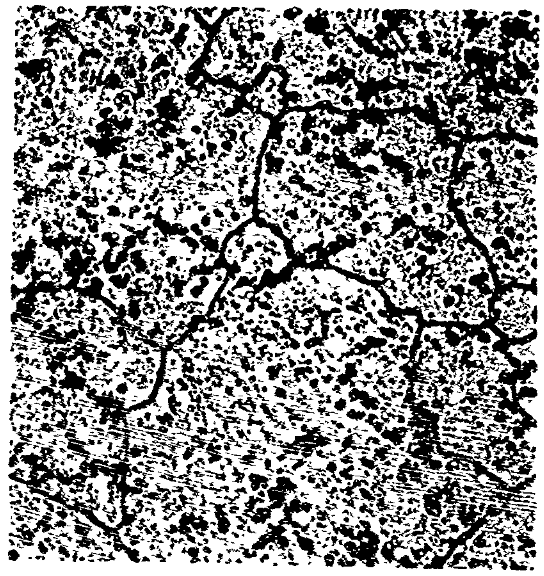
Typical microstructure of each billet is shown in Figure 1. Supplier tensile properties of each billet are presented in Table II.

TABLE I
CHEMICAL COMPOSITION LIMITS OF 2618 ALUMINUM ALLOY (QQ-A-367)

Cu	Si	Fe	Mg	Ti	Ni	Other	Al
1.9-2.7	0.25	0.9-1.3	1.3-1.8	0.04-0.10	0.9-1.2	0.05(1)	Bal.

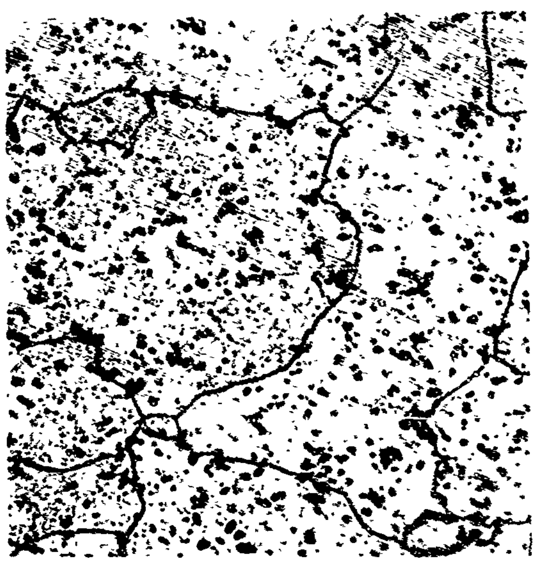
(1) Total of all elements not specified shall not exceed 0.15%.

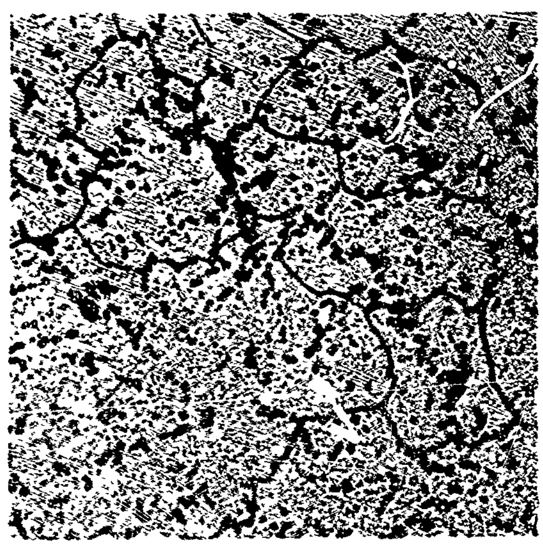




Alcoa Kaiser

(a) 3" x 6 1/2" Billet (a), Mid-Thickness
250X, Keller's Etch





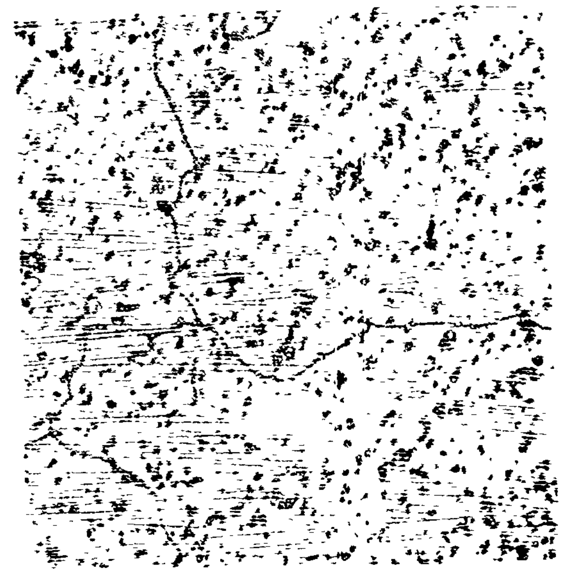
Alcoa Kaiser

(b) 4" x 8" Billet (b), Surface
250X, Keller's Etch

Figure 1

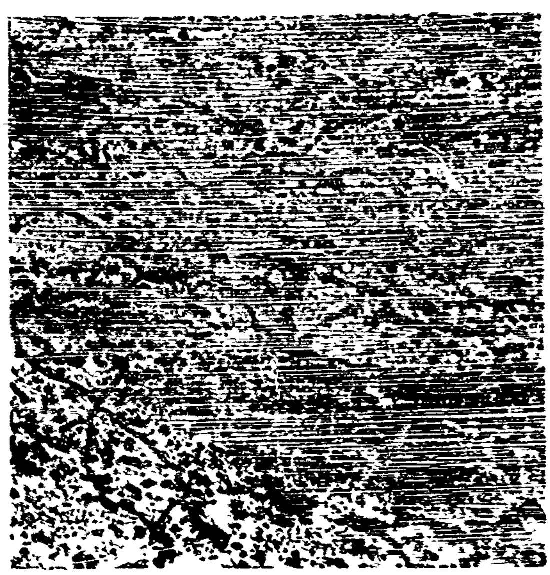
Typical Microstructure of 2618-T61 Billet Evaluated
Long Transverse Orientation

Alcoa

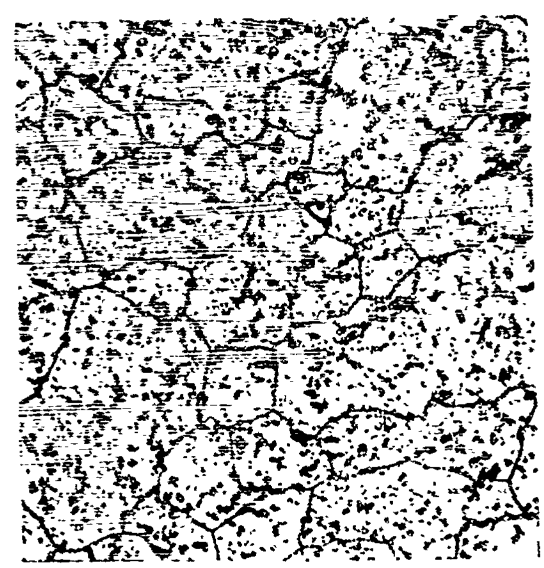


Kaiser

(c) 8" x 11" Billet (c), Mid-Thickness
250X, Keller's Etch



Kaiser, Mid-Thickness



Kaiser, Surface

(d) 4" x 8" Billet (d)
250X, Keller's Etch

Figure 1 Concluded

Table II

SUPPLIER HEAT TREATED TENSILE PROPERTIES
FOR TEST BILLET

Billet Size	Supplier	Direction	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
3" x 6-1/2"	Alcoa	L	63.8	55.0	8.0
		LT	61.4	53.0	8.0
Billet (a)		ST	59.7	51.1	4.0
	Kaiser	LT	62.0	49.9	8.0
		ST	68.1	52.9	6.5
4" x 8"	Alcoa	L	60.0	53.5	8.5
		LT	58.1	52.0	6.5
Billet (b)		ST	57.8	51.0	5.5
	Kaiser	LT	59.5	47.5	10.5
		ST	58.7	46.3	8.5
8" x 11"	Alcoa	L	60.0	55.5	10.5
		LT	55.0	42.0	8.5
Billet (c)		ST	57.8	44.5	8.0
	Kaiser	LT	59.0	47.4	7.0
		ST	58.7	48.9	5.0
4" x 8"					
Billet (d)	Kaiser	LT	62.0	53.0	7.0
QQ-A-367		L	57.0	47.0	7.0
		LT	55.0	45.0	5.0
Minimum		ST	52.0	42.0	4.0

Outline of Test Program:

An outline of the types of tests conducted, the total number of each type of test specimen, the billet location and direction of each test, and the test temperatures, are presented in Table III for billet (a), Table IV for billet (b), Table V for billet (c) and Table VI for billet (d).

Specimen Preparation:

All test specimen blanks were removed from the billets by band sawing or power hack sawing. Care was taken to insure that the billets did not overheat locally during the sawing operation and adequate material was provided each test blank to insure that all worked material was removed during the final machining operations. Illustrations showing the manner in which each billet was sectioned are shown in Figures 2, 3 and 4.

Test specimen configurations were in accordance with Federal Test Method Standard No. 151, ASTM Specifications or Recommended Procedures, and ARTC Report No. ARTC-13. The individual specimen configurations are shown in Figures 5 through 18.

All test specimens except the fatigue and creep specimens were identified by code so that the billet size, supplier, billet location and direction, and type of test could be determined from the marking on each specimen. An example of the code is as follows:

8ASTL52

The first one or two numbers identifies the billet,

8 indicates 4" X 8" billet
6 indicates 3" X 6½" billet
11 indicates 8" X 11" billet

The first letter identifies the supplier,

A indicates Alcoa
K indicates Kaiser

The second letter identifies the billet location,

S indicates surface
Q indicates quarter-thickness
M indicates mid-thickness

The third letter identifies the type of test,

T indicates tensile
N indicates notched tensile
P indicates compression
S indicates shear
B indicates bearing
F indicates fracture toughness
C indicates corrosion

The fourth letter identifies the billet direction,

L indicates longitudinal
T indicates long transverse
S indicates short transverse

The last one, two or three numbers identifies the specimen sequential number.

Consequently, specimen 8ASTL52 would be tensile specimen number 52 removed from the surface of the 4" X 8" Alcoa billet in the longitudinal direction.

Test Procedures

Tensile, notched tensile, shear, bearing, compression, and fracture toughness tests were conducted using three universal test machines, a 60,000 lb. Baldwin-Lima-Hamilton, a 120,000 lb. Baldwin-Lima-Hamilton, and a 150,000 lb. Compudyne. These machines are calibrated annually using National Bureau of Standards Certified Proving Rings and are accurate to within $\pm 1\%$. All machines are equipped with load-strain recorders and equipment for applying a constant strain rate to the specimen up to the yield point. Calibrated extensometers and compressometers (ASTM E83-64T, Class B-1) were used in conjunction with recorders to plot load-strain curves for tensile, bearing and compression tests.

Extension arms were utilized to locate the extensometers outside the test chamber for elevated temperature tests. A constant strain rate of 0.005 in/in/min. was applied up to the 0.2% offset yield strength with load rate being increased thereafter to cause failure within approximately one minute.

Measurements for area determination were made with micrometers to the nearest 0.001 inch.

Air circulating electrical resistance heated ovens were utilized for elevated temperature tests. Temperature was controlled automatically

Table III

OUTLINE OF TESTS CONDUCTED ON 3" X 6-1/2" BILLET (a)

Test	Determination	Total Specimens Per Supplier	Billet Location	Test Condition, °F 78	250	325	400	Total Specimens Tested
Tensile	F_{tu}, F_{ty}, e	48	Surface	3L	3L	3L	3L	
				3T	3T	3T	3T	
			Mid-Thick	3L	3L	3L	3L	
				3T	3T	3T	3T	96
Notched	F_{tu}	36	Surface	3L	-	3L	3L	
Tensile	Notched-to-			3T	-	3T	3T	
$K_t \geq 15$	Unnotched Ratio		Mid-Thick	3L	-	3L	3L	
				3T	-	3T	3T	72
Bearing	F_{bru}	18	Surface	3L	-	3L	3L	
e/D = 2.0	F_{bry}			3T	-	3T	3T	36
Shear	F_{su}	9	Surface	3L	-	-	-	
				3T	-	-	-	
				3ST	-	-	-	18
Compression	F_{cy}	9	Surface	3L	-	-	-	
				3T	-	-	-	
				3ST	-	-	-	18
Thermal	F_{tu}, F_{ty}, e	24	Surface	6L[3]	-	3L[1]	3L[1]	
Stability			(Edge)	6L[4]	-	3L[2]	3L[2]	48
Axial Fatigue				12L	-	-	-	
Unnotched		24	Mid-Thick	12T	-	-	-	48
R = 0.05	S-N Curves				-	-	-	
	10^3-10^7							
Axial Fatigue				12L	-	-	-	
Notched	Cycles	24	Mid-Thick	12T	-	-	-	48
K_t=2.4, R=0.05				-	-	-	-	
Creep	Up to 1% Creep in 1000 hours	8	Mid-Thick	-	4L	-	4L	16
Corrosion	Bend	9	Random	3L	-	-	-	18
				3T	-	-	-	
				3ST	-	-	-	
Corrosion	Axial Load	9	Random	3L	-	-	-	9
				3T	-	-	-	
				3ST	-	-	-	

1 Exposed for 100 hours at temperature indicated

2 Exposed for 1000 hours at temperature indicated

3 Exposed at 325°F; three for 100 hours, three for 1000 hours

4 Exposed at 400°F; three for 100 hours, three for 1000 hours

5 Alcoa Billet only

Table IV

OUTLINE OF TESTS CONDUCTED ON 4" X 8" BILLET (b)

Test	Determination	Total Specimens Per Supplier	Billet Location	Test Temperature °F 78	250	325	400	Total Specimens
Tensile	F_{tu}, F_{ty}, E_t, e	84	Surface	3L	3L	3L	3L	168
				3T	3T	3T	3T	
			Quarter-Thick	3L	3L	3L	3L	
				3T	3T	3T	3T	
			Mid-Thick	3L	3L	3L	3L	
				3T	3T	3T	3T	
				3ST	3ST	3ST	3ST	
Notched Tensile $K_t > 15$	F_{tu} Notched-to Unnotched Ratio	84	Surface	3L	3L	3L	3L	168
				3T	3T	3T	3T	
			Quarter-Thick	3L	3L	3L	3L	
				3T	3T	3T	3T	
			Mid-Thick	3L	3L	3L	3L	
				3T	3T	3T	3T	
				3ST	3ST	3ST	3ST	
Bearing e/D = 2.0	F_{bru}, F_{bry}	30	Surface	3L	3L	3L	3L	60
				3T	3T	3T	3T	
			Quarter-Thick	3L	-	-	-	
			Mid-Thick	3L	-	-	-	
Shear	F_{su}	42	Surface	3L	3L	3L	3L	84
				3T	3T	3T	3T	
				3ST	3ST	3ST	3ST	
			Quarter-Thick	3L	-	-	-	
			Mid-Thick	3L	-	-	-	
Compression	F_{cy}, E_c	21 Kaiser 30 Alcoa	Surface	3L	3L	3L	3L	51
				3T	3T[8]	3T[8]	3T[8]	
			Quarter-Thick	3L	-	-	-	
			Mid-Thick	3L	-	-	-	
Thermal Stability	F_{tu}, F_{ty}	144	Surface	9L[4]	3L[1]	3L[1]	3L[1]	288
				9L[5]	3L[2]	3L[2]	3L[2]	
				9L[6]	3L[3]	3L[3]	3L[3]	
				9T[4]	3T[1]	3T[1]	3T[1]	
				9T[5]	3T[2]	3T[2]	3T[2]	
				9T[6]	3T[3]	3T[3]	3T[3]	
			Mid-Thick	6L[9]	3L[1]	3L[1]	3L[1]	
				6L[10]	3L[2]	3L[2]	3L[2]	
				6L[11]	-	-	-	

Table IV - Continued

Test	Determination	Total Specimens Per Supplier	Billet Location	°F 78	250	325	400	Total Specimens
Axial Fatigue Unnotched $R = 0.05$	S-N-Curves 10^3-10^7 Cycles	50[7]	Mid-Thick	25L	-	-	-	74
				25T	-	-	-	
		24[8]		12L	-	-	-	
				12T	-	-	-	
Axial Fatigue Notched, $K_t = 2.4$, $R = 0.05$		50[7]	Mid-Thick	25L	-	-	-	74
				25T	-	-	-	
		24[8]		12L	-	-	-	
				12T	-	-	-	
Rotating Beam Unnotched $R = -1$	S-N Curves 10^3-10^7 Cycles	125[7]	Surface (Edge)	25L	25L	-	25L	
			Quarter-Thick	25L	-	-	-	
			Mid-Thick	25L	-	-	-	
		36[8]	Surface (edge)	12L	-	-	12L	161
			Mid-Thick	12L	-	-	-	
Rotating Beam, $K_t = 2.4$ $R = -1$		100[7]	Surface (Edge)	25L	25L	-	-	100
			Mid-Thick	25L	-	-	25L	
Creep	Up to 1% Creep in 1000 hours	30[7]	Mid-Thick	-	10L	10L	10L	38
		8[8]		-	4L	-	4L	

1 Exposed for 10 hours at temperature indicated.
2 Exposed for 100 hours at temperature indicated.
3 Exposed for 1000 hours at temperature indicated.
4 Exposed at 250°F; three for 10 hours, three for 100 hours, three for 1000 hours.
5 Exposed at 325°F; three for 10 hours, three for 100 hours, three for 1000 hours.
6 Exposed at 400°F; three for 10 hours, three for 100 hours, three for 1000 hours.
7 Specimens removed from Alcoa billet only.
8 Specimens removed from Kaiser billet only.
9 Exposed at 250°F; three for 10 hours, three for 100 hours.
10 Exposed at 350°F; three for 10 hours, three for 100 hours.
11 Exposed at 400°F; three for 10 hours, three for 100 hours.

Table V

OUTLINE OF TESTS CONDUCTED ON 8" X 11"
BILLET (c)

Test	Determination	Total Specimens Per Supplier	Billet Location	78 °F	250 °F	325 °F	400 °F	Total Specimens
Tensile	F_{tu}, F_{ty}, E_t, e	63	Surface (Side)	3L	-	3L	3L	126
				5ST	-	2ST	2ST	
			Quarter-Thick (11"Dim)	3L	-	3L	3L	
				5ST	-	2ST	2ST	
				5T		2T	2T	
			Mid-Thick	3L	-	3L	3L	
				5T	-	2T	2T	
Notched Tensile K_t > 15	F_{tu} Notched-to-Unnotched Ratio	54	Quarter-Thick (11" Dim)	3L	-	3L	3L	108
				3T	-	3T	3T	
			Mid-Thick	3L	-	3L	3L	
				3T	-	3T	3T	
			Surface (Side)	3L	-	3L	3L	
				5T	-	2T	2T	
Bearing e/D = 2.0	F_{bru}, F_{bry}	6	Surface (Side)	3L	-	-	-	12
				3T	-	-	-	
Compression	F_{cy}, E_c	9	Surface (Side)	3L	-	-	-	18
				3T	-	-	-	
				3ST	-	-	-	
Thermal Stability	F_{tu}, F_{ty}, e	24	Surface (Edge)	6L[3]	-	3L[1]	3L[1]	48
				6L[4]	-	3L[2]	3L[2]	
Axial Fatigue Unnotched R = 0.05	S-N-Curves	36	Mid-Thick	12L	-	-	-	72
				12T	-	-	-	
			Edge	12L	-	-	-	
Axial Fatigue Notched, K_t = 2.4 R = 0.05	10^3-10^7 Cycles	36	Mid-Thick	12L	-	-	-	72
				12T	-	-	-	
			Edge	12L	-	-	-	
Creep	Up to 1% Creep in 1000 Hours	8	Mid-Thick	-	4L	-	4L	16
Shear	F_{su}	6	Surface (Side)	3L	-	-	-	12
				3T	-	-	-	

1 Exposed 100 hours at temperature indicated.
2 Exposed 1000 hours at temperature indicated.
3 Exposed at 325°F; three for 100 hours, three for 1000 hours.
4 Exposed at 400°F; three for 100 hours, three for 1000 hours.

Table VI

OUTLINE OF TESTS CONDUCTED ON 4" X 8" BILLET (d)

Test	Determination	Total Specimens	Billet Location	Test Temperature °F 78	250	325	400
Tensile	F_{tu}, F_{ty}, E_t, e	57	Surface	3L	-	-	-
				3T	3T	3T	3T
			Quarter-Thick	3L	-	-	-
				3T	3T	3T	3T
			Mid-Thick	3L	-	-	-
				3T	3T	3T	3T
				3ST	3ST	3ST	3ST
Bearing e/D = 2	F_{bru}, F_{bry}	12	Surface	3L	-	-	-
				3T	-	-	-
			Quarter-Thick	3L	-	-	-
			Mid-Thick	3L	-	-	-
Shear	F_{su}	15		3ST	-	-	-
			Surface	3L	-	-	-
				3T	-	-	-
			Quarter-Thick	3L	-	-	-
			Mid-Thick	3L	-	-	-
Compression	F_{cy}, E_c	45	Surface	3L	-	-	-
				3T	3T	3T	3T
				6ST	6ST	6ST	6ST
			Quarter-Thick	3L	-	-	-
			Mid-Thick	3L	-	-	-
Corrosion	Bend and Axial (9 each)	18	Random	6L	-	-	-
				6T	-	-	-
				6ST	-	-	-
Fracture Toughness	K_{IC}	18	Surface	3L	-	-	-
				3T	-	-	-
			Quarter-Thick	3L	-	-	-
				3T			
			Mid-Thick	3L	-	-	-
				3T	-	-	-
Thermal Stability	F_{tu}, F_{ty}	36	Mid-Thick	6(2)	6(1)	6(1)	6(1)
				6(3)			
				6(4)			

1 Exposed for 1,000 hours at temperatures indicated.
2 Exposed at 250°F, for 1,000 hours.
3 Exposed at 325°F, for 1,000 hours.
4 Exposed at 400°F, for 1,000 hours.

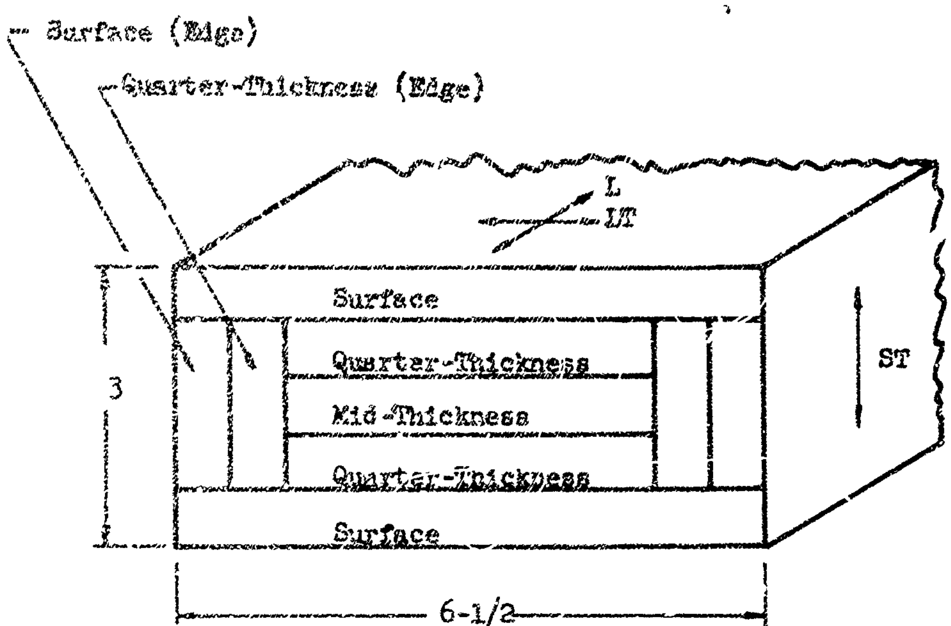


FIGURE 2
METHOD OF SECTIONING 3" x 6-1/2" BILLET (a)
(All dimensions are inches)

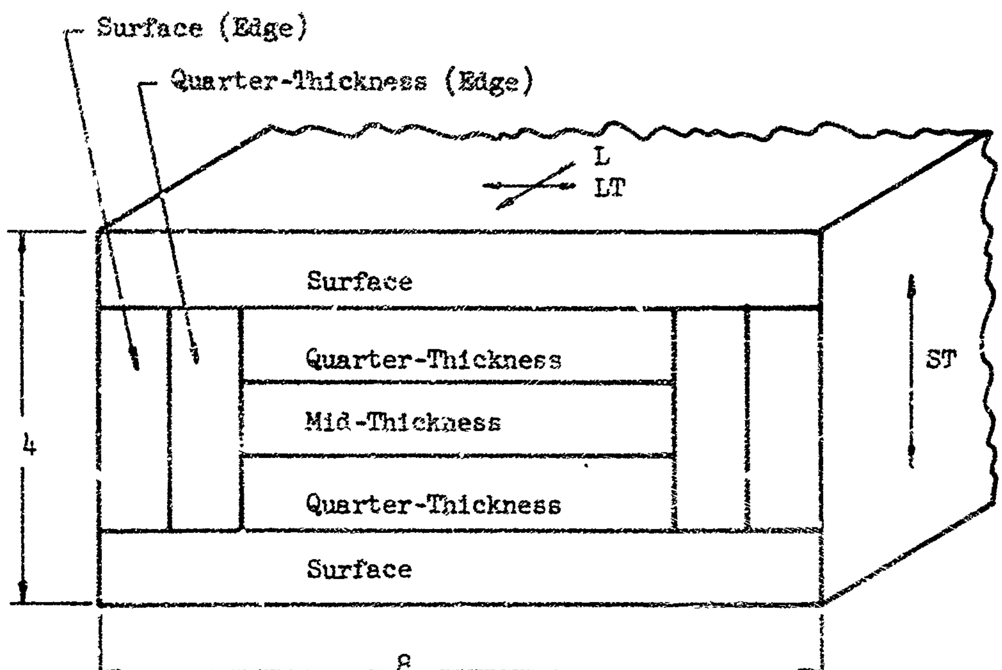


FIGURE 3
METHOD OF SECTIONING 4" x 8" BILLETS (b) and (d)
(All dimensions are inches)

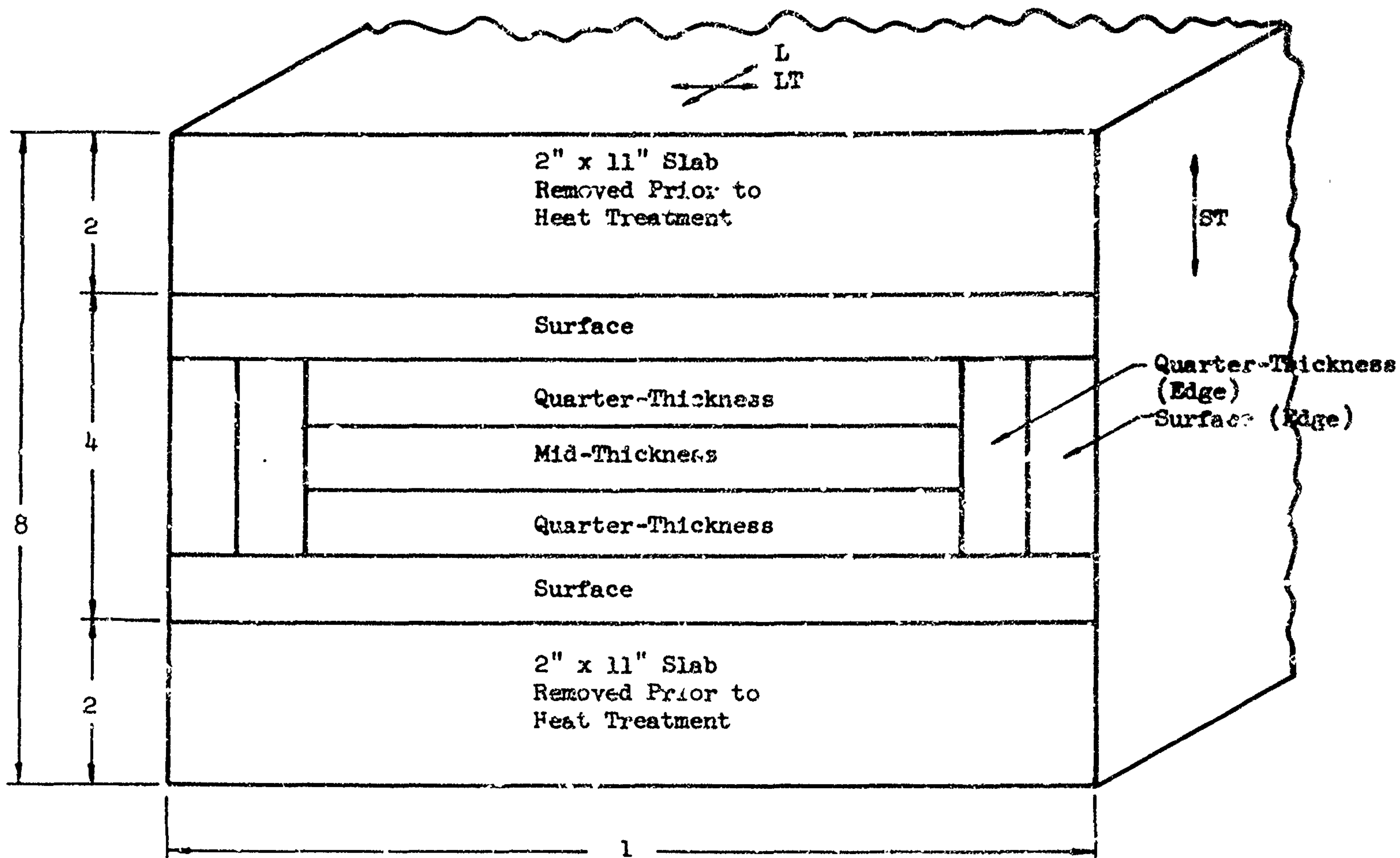


FIGURE 4
METHOD OF SECTIONING 8" X 11" BILLET (c)

(All dimensions are inches)

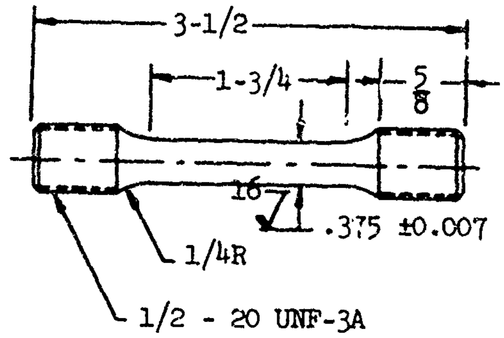


Figure 5

Room and Elevated Temperature Tensile and Tensile Stability Test Specimen

(All dimensions are inches)

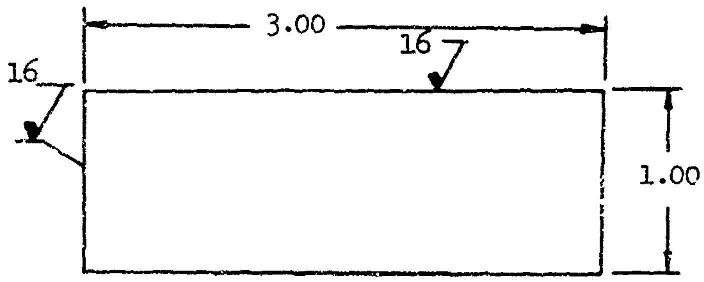


Figure 6

Room and Elevated Temperature Compression Test Specimen

(All dimensions are inches)

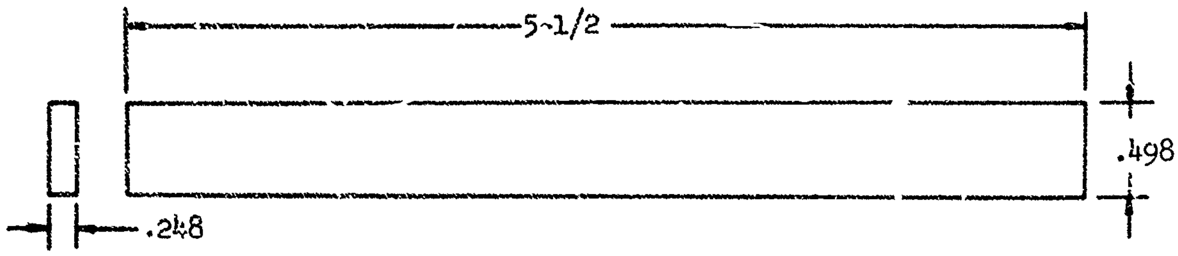


Figure 7

Room and Elevated Temperature Shear Test Specimen
(All dimensions are inches)

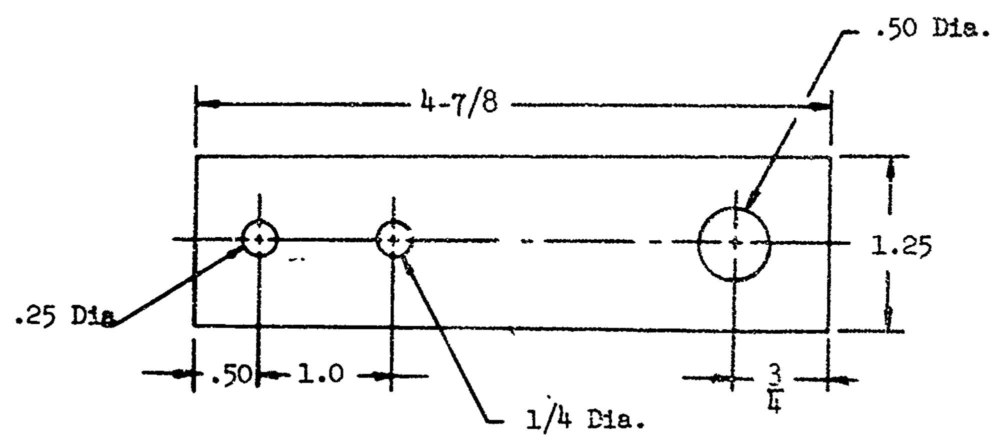


Figure 8

Room and Elevated Temperature Bearing Test Specimen
e/D = 2.0

(All dimensions are inches)

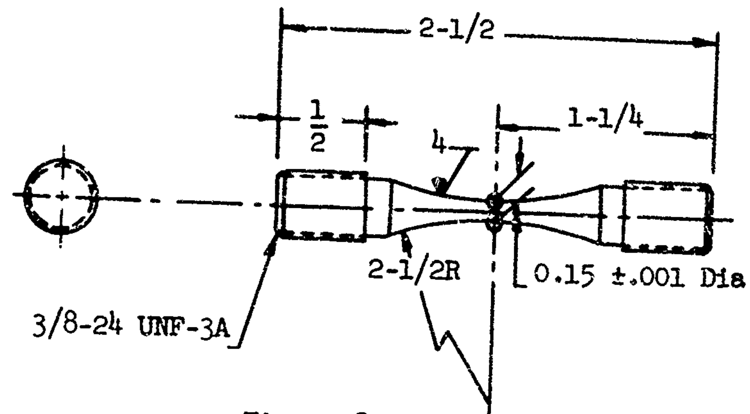


Figure 9
Unnotched Axial Load Fatigue
Test Specimen

(All dimensions are inches)

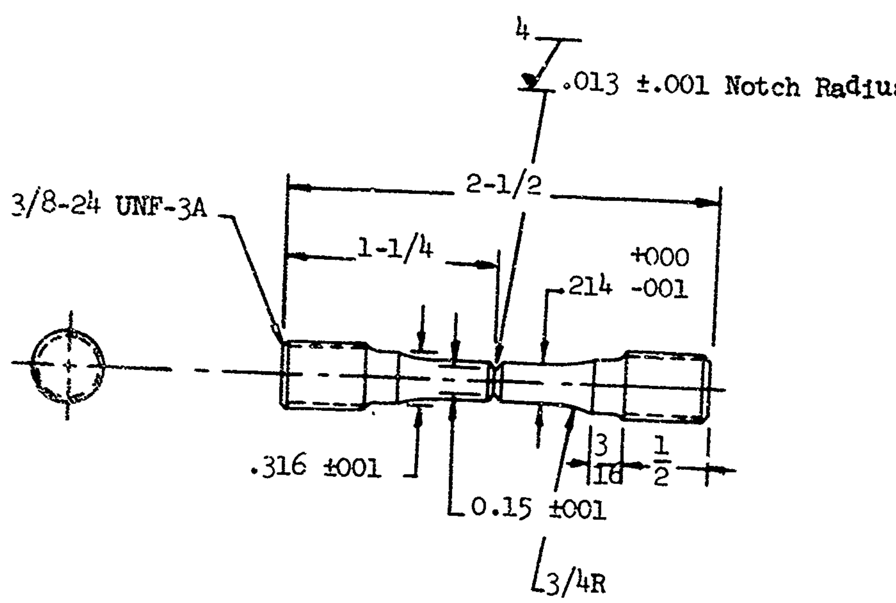
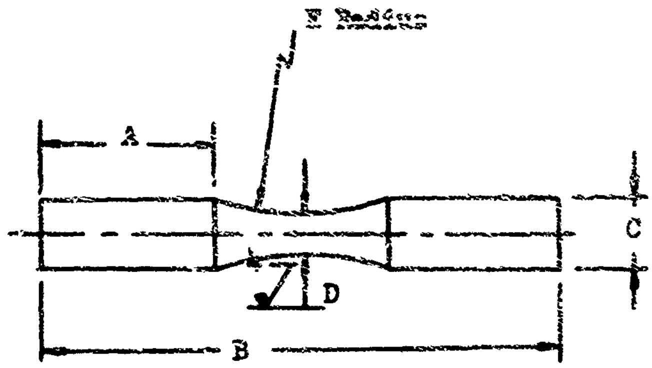


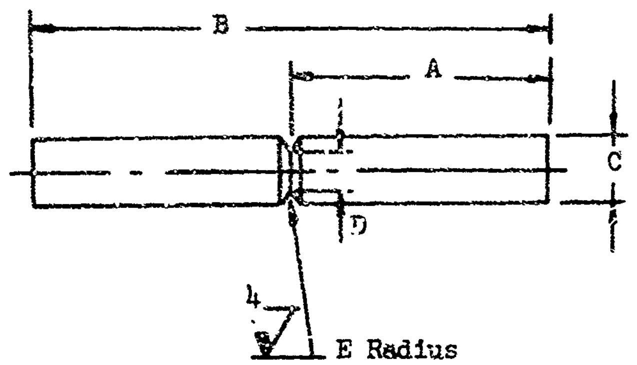
Figure 10
Notched K_t = 2.4, Axial Load Fatigue
Test Specimen

(All dimensions are inches)



A	B	C	D	E
1	3	.375	.245 ±.001	2
1-1/4	4	.500	.275 ±.001	2.5

Figure 11
Unnotched Rotating Beam Fatigue Test Specimens
(All dimensions are inches)



A	B	C	D	E
1.5	3	.375	.245 ±.001	.014 ±.001
2	4	.500	.275 ±.001	.016 ±.001

Figure 12
Notched K_t = 2.4, Rotating Beam Fatigue Test Specimen
(All dimensions are inches)

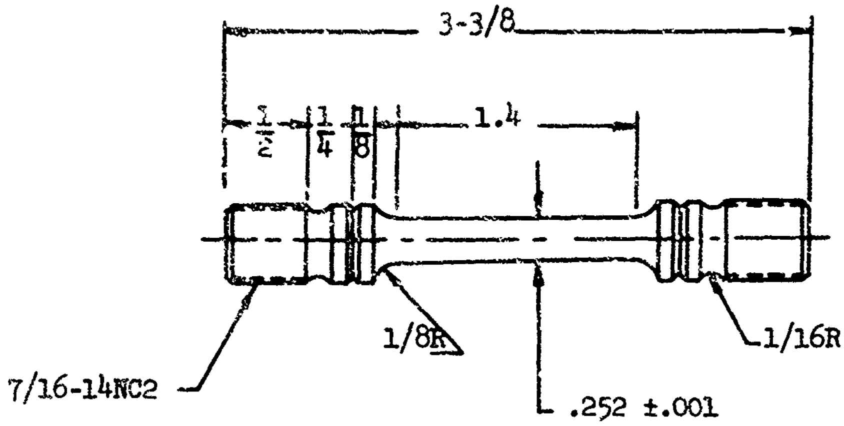


Figure 13
Creep Test Specimen
(All dimensions are inches)

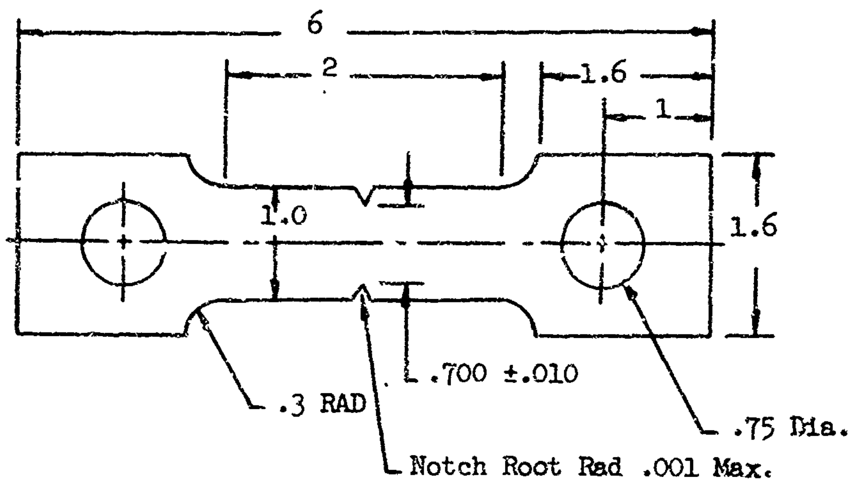


Figure 14
Room and Elevated Temperature Notch Tensile Specimen, $K_t > 15$
(All dimensions are inches)

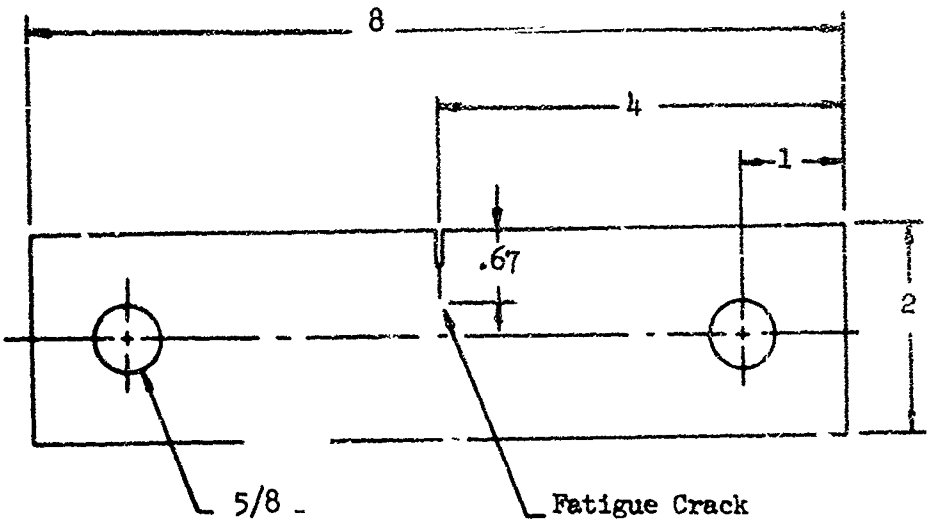


Figure 15
Single-Edge-Notch Fracture Toughness Test Specimen
(All dimensions are inches)

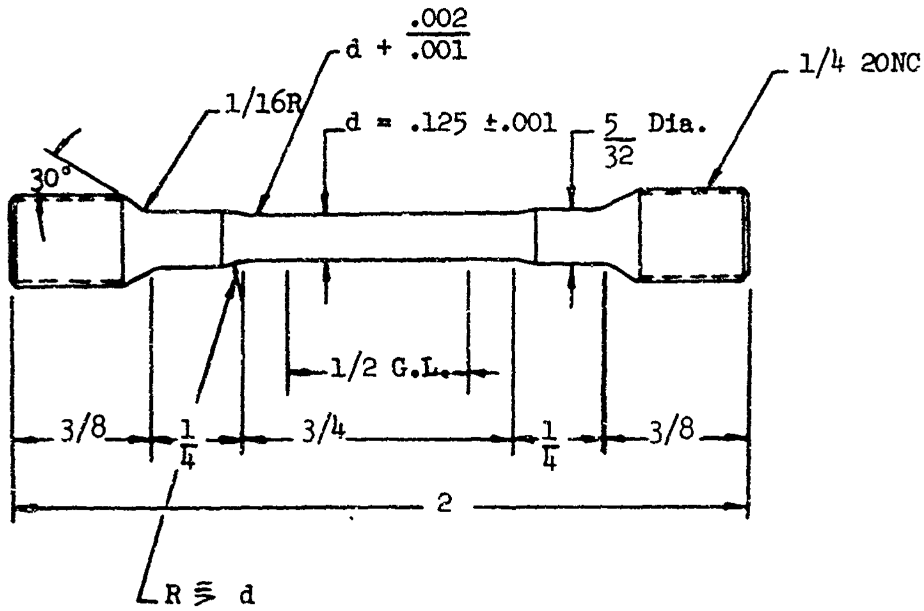


Figure 16
Axial Stress Corrosion Specimen
(All dimensions are inches)

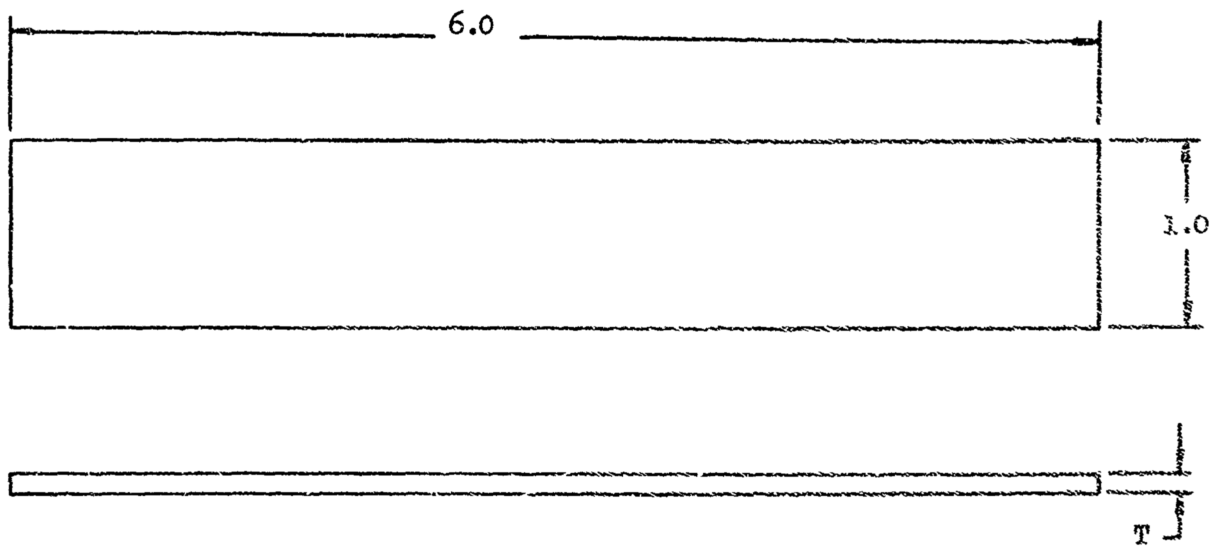


Figure 17
Stress Corrosion Bend Specimen
Longitudinal and Long Transverse

(All dimensions are inches)

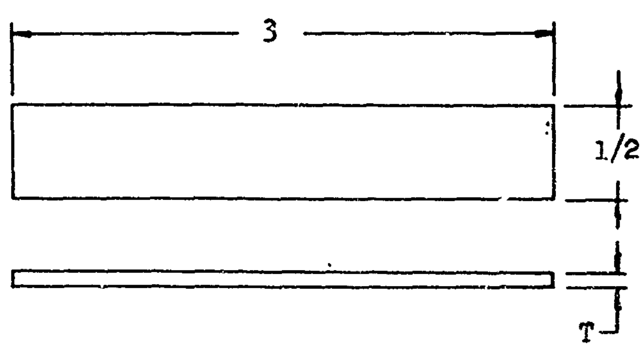


Figure 18
Stress Corrosion Bend Specimen
Short Transverse

(All dimensions are inches)

using a thermocouple attached near the specimen test section. Specimens were soaked for one-half hour prior to testing to insure temperature stabilization. Tensile thermal stability specimens were exposed using a bank of automatically temperature controlled ovens.

Tensile tests were conducted using a 1.4 inch gage length. Total elongation was determined by fitting the failed specimens together and using calipers to measure the change in length of the 1.4 inch gage marks. Tensile modulus was determined from the autographically plotted load-deformation curves.

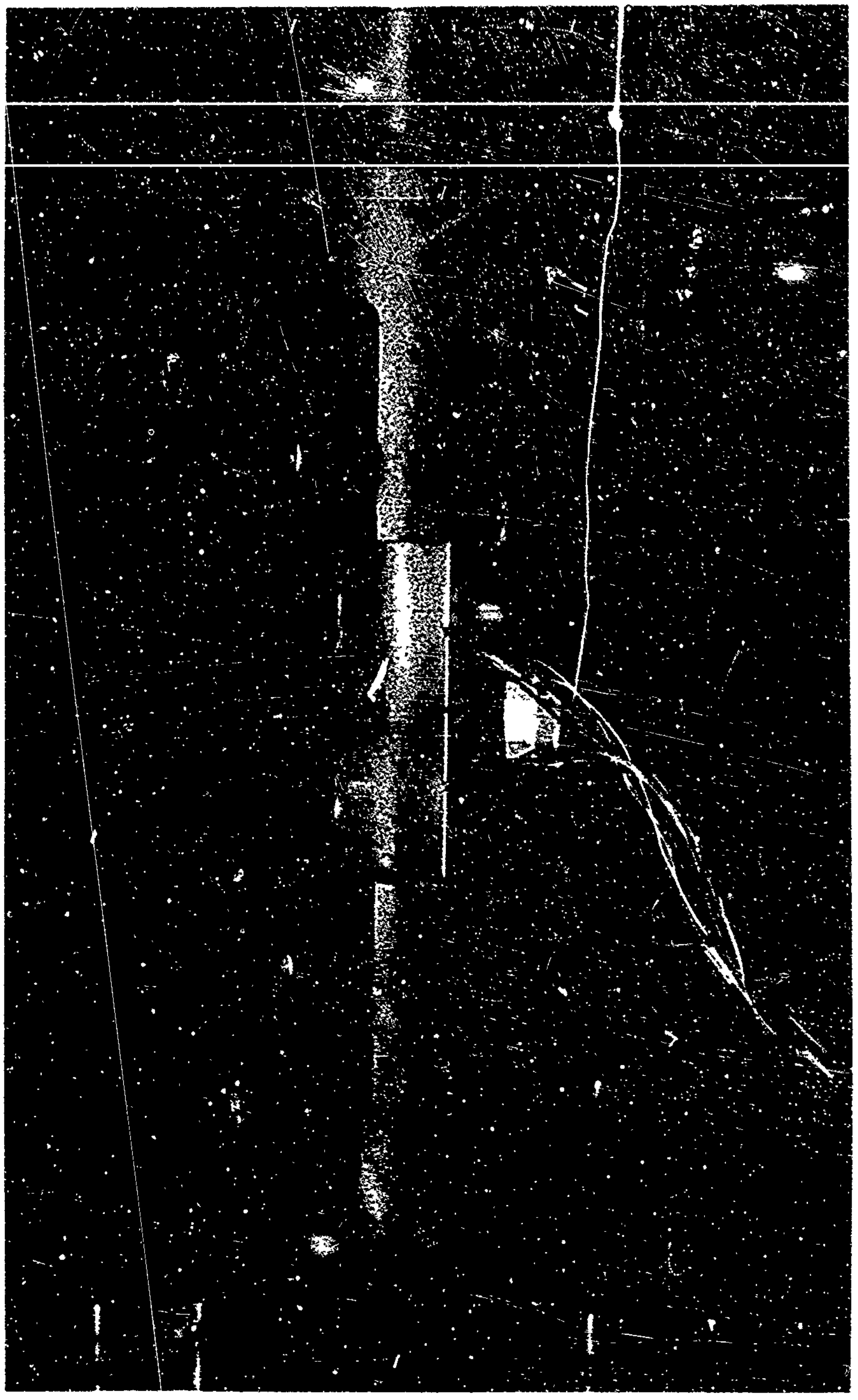
Shear tests were accomplished in a single shear fixture which can be utilized for both room and elevated temperature tests. Specimen test section was 1/4 by 1/2 inches.

Bearing tests were performed using a clevis and pin arrangement to load a 0.25 inch diameter hole. Specimens were machined to a thickness of 0.090 to 0.125 inches.

Compression test specimens were machined to a thickness of 0.112 to 0.165 inches. Specimens were supported in a special fixture having lateral support guides to prevent buckling. The same test set-up was used for both room and elevated temperature tests. Compression modulus was determined from the autographically plotted load-deformation curves.

Fracture toughness tests were conducted in accordance with the latest recommendations of ASTM Committee E-24. Specimens were machined to 0.25 inch thickness with the initial slot being cut with a slitting wheel. Fatigue cracks were generated at the slot using tension-tension loading at a stress level of approximately 15% of the material yield strength. Cracks of the proper length were generated in 50,000 to 100,000 cycles. The load at which "pop-in" or initial plane strain fracturing occurred was determined by using the mechanical compliance technique. The compliance gage, shown mounted on a test specimen in Figure 19, has a strain gage attached to each side of each arm, with all four gages being active arms of a bridge circuit. The arms are strained by bending them slightly to fit into the machined slots on the edge of the specimen. As the specimen deforms during loading the change in strain in the arms is recorded versus load on an X-Y plotter.

The compliance gage is calibrated before each series of tests using an extensometer calibrating device and is linear within $\pm 0.5\%$ over the deformation range utilized.



Mag: Approx. 7/16X

Figure 19

Fracture Toughness Test Set-Up
Showing Compliance Gage Attached
To Test Specimen

Axial load fatigue tests were conducted using a Krouse plate bending machine equipped with a 750 lb. Krouse direct stress attachment. Cycles were applied at a rate of 1800 per minute. Tests were conducted using a stress ratio, R, (minimum to maximum stress) of 0.05. Room temperature tests only were conducted on the axial load specimens. Stress levels were chosen to produce failures in from 10^3 to 10^7 cycles.

Rotating beam fatigue tests were conducted on a Krouse simple-beam type fatigue machine having a capacity of 850 in-lb. Tests were conducted at a rate of 5000 cycles per minute at a stress ratio, R, of -1.0. Tests were conducted at room temperature, 250°F and 400°F. Elevated temperatures were obtained using a split electrical resistance heated furnace with automatic temperature control. Stress levels were chosen to produce failures in from 10^3 to 10^7 cycles.

Creep-stress-rupture tests were conducted using seven 12,000 lb. Arcweld dead weight creep frames equipped with automatically controlled tubular electrical resistance heated furnaces. Strain was continually recorded throughout the tests using a transducer extensometer system. Various dead weight loads were applied to obtain creep deformations up to 1% in times up to 1000 hours. Tests were conducted at 250°F, 325°F and 400°F.

Stress corrosion tests were conducted using both axial tension and bent beam specimens. The axial tension specimens were of the constant deflection type and were stressed in a picture frame fixture. The applied stresses were determined by using the strain, measured by a Huggenberger extensometer attached to the $\frac{1}{2}$ inch gage length reduced section, in conjunction with the modulus of the material. The bent beam specimens were of the constant moment type, stressed by applying a moment to each end of the beam. Stresses applied to the beam specimens were determined using the reading from a strain gage attached to the surface of each specimen, in conjunction with the modulus of the material. Exposure of the stress corrosion specimens was accomplished using a "ferris wheel" type machine which enabled the specimens to be immersed in a $3\frac{1}{2}$% salt solution for ten minutes and air dried in a normal laboratory atmosphere for fifty minutes. A photograph of this equipment is shown in Figure 20. The alternate immersion and air drying exposure was repeated until specimen failure or for a maximum time period of twelve weeks. All specimens were inspected at the start and end of each working day. Specimens were considered failed when cracks could be seen under 4X magnification; however, most specimens failed completely before cracks were detected. Inspection for cracks was difficult after long periods of exposure (over 4 weeks) because of the build-up of salt on the specimen surface.

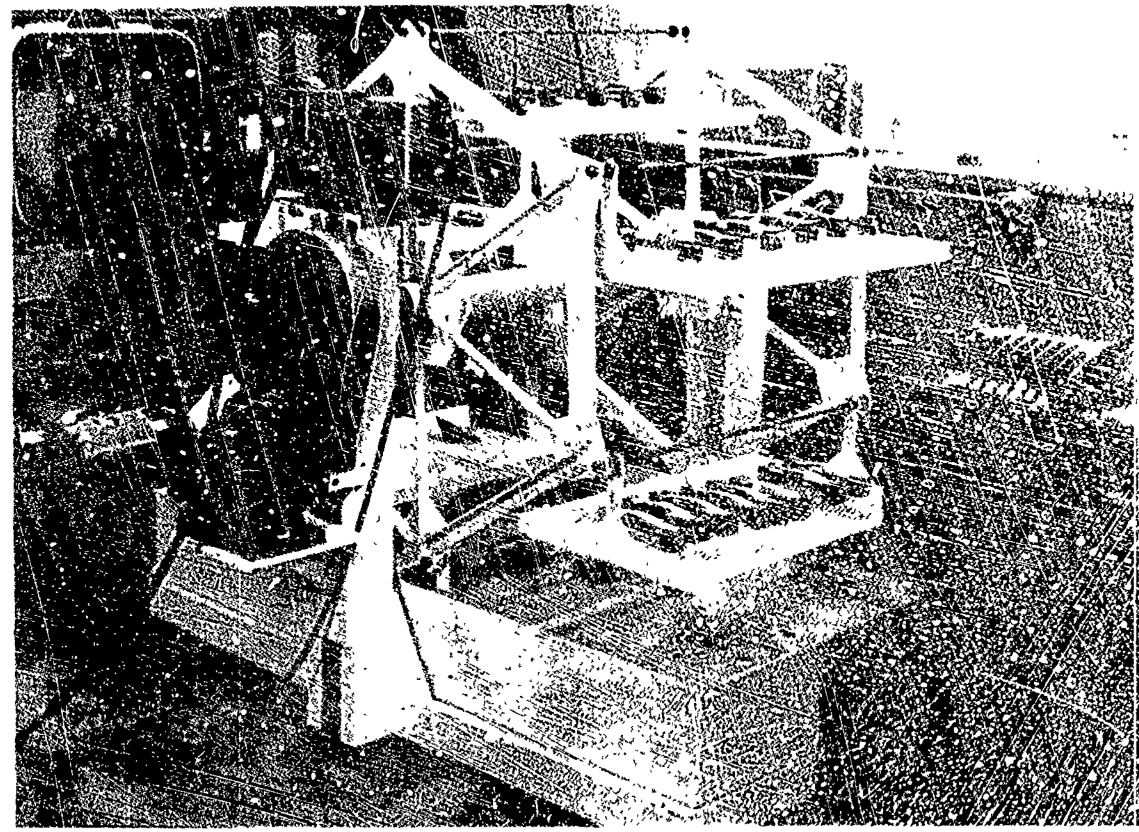


Figure 20

Alternate Immersion Corrosion Equipment

Data Analysis

Static Tests: Tensile, compressive, shear and bearing room temperature mechanical property test results were statistically analyzed for the determination of "A" and "B" values as defined in MIL-HDBK-5, August, 1963, Chapter 3, Section 3.1.1.1.1. An "A" value is one above which 99 percent of the population will fall with a confidence of 95 percent. The "B" value is one above which 90 percent of the population will fall with 95 percent confidence.

The calculated values were determined in the following manner:

$$\text{"A" value} = \bar{X} - K_{.99}\ S_x \qquad (1)$$

$$\text{"B" value} = \bar{X} - K_{.90}\ S_x \qquad (2)$$

where:

$$\bar{X} = \text{arithmetic mean} = \frac{\Sigma x}{n}$$

and x indicates the individual test results for n number of tests

$$S_x = \text{standard deviation} = \sqrt{\frac{\Sigma(x-\bar{X})^2}{n-1}}$$

The values of K were obtained from the table, "One-Sided Tolerance Factors for the Normal Distribution and a Confidence, γ, of .95" in Tables of Normal Probability Functions", National Bureau of Standards, Applied Mathematics Series 23, (1953).

Fracture Toughness: The K_{Ic} values were calculated using the experimental compliance measurement procedure and expression for K_{Ic} developed by Srawley, Brown, Gross and Jones, References (1) and (2). The compliance measurements reported in these references are applicable to all materials, providing the same proportional specimen size is utilized. An expression for K_{Ic} which was derived from the compliance measurements is given in Reference (1) and shown below:

$$K_{Ic}^2 = \frac{P^2}{B^2W(1-\nu^2)}\ 7.59\ a/W - 32(a/W)^2 + 117(a/W)^3 \qquad (3)$$

where:

P = Load at "pop-in" (lbs)
B = Thickness of specimen (in)
W = Width of specimen (in)
ν = Poisson's ratio

$$a = a_o + \frac{K_{Ic}^2(1-\nu^2)}{6\pi \sigma_{ys}} \qquad (4)$$

and a_o = crack length as measured on fracture surface

σ_{ys} = 0.2% offset yield strength of the material.

Values of a were calculated by using a_o values in (3) to calculate approximate values of K_{Ic}. These approximate K_{Ic} values were then used in (4) to approximate the a values, which were inserted back into (3) to calculate the reported K_{Ic} values. Further iteration could give more exact values of K_{Ic}; however, it is felt that this first approximation produced values within the experimental errors involved.

SECTION III

DATA PRESENTATION

Design Properties: Room temperature mechanical property "A" and "B" design values determined during the present program for F_{tu}, F_{ty}, F_{cy}, F_{su}, F_{bu}, F_{by}, and e, in the longitudinal, long transverse and short transverse directions are presented in Table VII in a manner similar to that used in MIL-HDBK-5. These values were determined as explained in the previous "Data Analysis" section of this report by using data from (1) the three billet locations (surface, quarter-thickness and mid-thickness), (2) the various billet sizes (3" x $6\frac{1}{2}$", 4" x 8", 8" x 11"), and (3) the two suppliers, as the total population for each billet direction analyzed. As an example, the F_{tu} "A" and "B" values given in Table VII for the longitudinal direction, were determined from test results of specimens removed from the various billets, locations, and suppliers shown in note (1) of Table VIII. Note (1) shows that 12 of the 57 tests for the F_{tu} determination were from billet (a), (billet (a) was obtained from two suppliers and three specimens were removed from two locations in each billet, for a total of 12 specimens), 18 of the 57 tests were from billet (b), 18 of the 57 tests were from billet (c), and 9 of the 57 tests were from billet (d).

Tensile and compressive modulus values and the physical properties are also shown in Table VII. The modulus values for each billet direction were obtained in the same manner as above; however, they are average values for each direction for all billet locations, billet sizes, and suppliers, not statistically determined "A" or "B" values. The physical properties shown in Table VII are those presently shown in MIL-HDBK-5, since no physical properties were determined during this program.

Elevated Temperature Properties: A summary of the average elevated temperature test results for tension, compression, shear bearing and modulus of all the billets evaluated is presented in Table IX. These results are for one-half hour temperature exposure. A summary of the average tension properties of all billets evaluated after exposure at elevated temperatures for 10, 100 and 1000 hours is presented in Table X.

Graphical presentations, similar to those used in MIL-HDBK-5, showing the effect of temperature on tension, notched tension, compression, shear, bearing and modulus properties are presented in Figures 21 through 36.

Stress-Strain Diagrams: Typical tension and compression stress-strain curves for room temperature, 325°F and 400°F are presented in Figures 37 and 38. The slope of the straight line portion of the curves was made equal to the average elastic modulus values. The remainder of the curves were constructed using engineering judgement and observation of actual load-deformation curves recorded during the tests.

Axial Load Fatigue: Unnotched axial load fatigue properties at room temperature are presented as S-N curves in Figures 39 and 40 respectively, for the longitudinal and long transverse directions. Notched properties, $K_t = 2.4$ are presented in Figures 41 and 42.

Rotating Beam Fatigue: Unnotched and notched, $K_t = 2.4$, rotating beam fatigue properties at room temperature are presented as S-N curves in Figure 43. Elevated temperature rotating beam fatigue properties are presented in Figure 44.

Creep Properties: Stress versus time curves for various amounts of creep deformation, and stress versus time curves to cause creep-rupture are presented in Figures 45 through 47 for test temperatures of 250°F, 325°F and 400°F.

Fracture Toughness: Fracture toughness properties at room temperature for three billet locations and two billet directions are presented in Table XI.

Stress Corrosion: Stress corrosion properties determined using axial loaded test specimens are presented in Table XII, while bend test stress corrosion properties are presented in Table XIII.

Tabulated Raw Data: All test data developed during the program, including all data obtained prior to initiation of this contract, are tabulated in Appendix A. The data are arranged in an orderly fashion with all tensile data from the various billets arranged in one group of tables, all compressive data in another group of tables, etc.

Table VII

SUGGESTED

DESIGN MECHANICAL AND PHYSICAL PROPERTIES OF 2618 ALUMINUM ALLOY HAND FORGED BILLET

Alloy		2618	
Form		Hand Forged Stock	
Condition		-T61	
Thickness, (in)		≤ 4 Inches	
Cross-sectional area, (in^2)		$> 18, \leq 44$	
Basis		A	B
Mechanical Properties:			
F_{tu}, Ksi	L	59	60
	LT	56	58
	ST	54	57
F_{ty}, Ksi	L	44	46
	LT	43	45
	ST	42	45
F_{cy}, Ksi	L	47	50
	LT	43	47
	ST	43	47
F_{su}, Ksi	L	35	38
	LT	37	39
	ST	35	37
F_{bu}, Ksi e/D=2.0	L	112	117
	LT	114	119
F_{by}, Ksi e/D=2.0	L	78	83
	LT	79	84
e, Percent	L	6	8
	LT	4	5
	ST	4	5
E, 10^6 psi		10.3	
Ec, 10^6 psi		10.6	
Physical Properties: (1)			
ω, lb/in^3		0.100	
C, BTU/(lb) (°F)		0.23 (at 212°F)	
K, BTU/ (hr) (ft^2) (°F)/ft		90.0 (at 77°F)	
α, 10^{-6} in/in/°F		12.3 (68° to 212°F)	

(1) Data not determined during this program, values are from MIL-HDBK-5

Table VIII

SUMMARY OF AVERAGED AND STATISTICAL, TENSILE, COMPRESSIVE, SHEAR AND BEARING TEST RESULTS FOR ALL 2618-T61 BILLETS EVALUATED AT ROOM TEMPERATURE

Mechanical Property	Billet Direction	Total Tests	Test Average	Standard Deviation	Determined During Present Program A	Determined During Present Program B	Present MIL-HDBK-5 Data A
Tensile Ultimate	L	57(1)	62.7	1.43	58.7	60.4	57
	LT	59(2)	60.2	1.62	55.6	57.6	55
	ST	29(3)	59.9	1.89	54.1	56.5	52
Tensile Yield	L	57(1)	50.0	2.21	43.8	46.4	47
	LT	59(2)	48.5	2.19	42.4	45.0	45
	ST	29(3)	48.5	2.21	41.7	44.5	42
Elongation	L	57(1)	10.7	1.66	6.0	8.0	7
	LT	57(4)	7.1	1.29	3.5	5.0	5
	ST	29(3)	6.6	.85	4.0	5.1	4
Compressive Yield	L	39(5)	54.0	2.25	47.4	50.2	--
	LT	21(7)	52.5	2.91	43.3	47.1	--
	ST	18(8)	52.8	2.86	43.1	47.1	--
Shear Ultimate	L	39(5)	42.9	2.86	34.5	38.0	--
	LT	21(7)	41.7	1.40	37.1	39.0	--
	ST	15(9)	40.5	1.66	34.6	37.1	--
Bearing Ultimate	L	39(5)	124.0	4.09	111.9	117.0	--
	LT	21(7)	125.2	3.31	114.4	118.9	--
Bearing Yield	L	38(6)	90.4	4.20	78.0	83.2	--
	LT	21(7)	90.9	3.68	78.9	83.9	--
Tensile Modulus		(10)	10.3				--
Compressive Modulus		(11)	10.6				10.8

Table VIII - Continued

(1) 12 tests from billet (a), 3 specimen from 2 locations and 2 suppliers
18 tests from billet (b), 3 specimen from 3 locations and 2 suppliers
18 tests from billet (c), 3 specimen from 3 locations and 2 suppliers
9 tests from billet (d), 3 specimen from 3 locations and 1 supplier

(2) Same as note (1) except 20 tests from billet (c), 5 specimens from 2 locations and 2 suppliers

(3) 6 tests from billet (b), 3 specimen from 1 location and 2 suppliers
20 tests from billet (c), 5 specimen from 2 locations and 2 suppliers
3 tests from billet (d), 3 specimen from 1 location and 1 supplier

(4) Same as note (2) except 2 values from billet (c) dropped

(5) 6 tests from billet (a), 3 specimen from 1 location and 2 suppliers
18 tests from billet (b), 3 specimen from 3 locations and 2 suppliers
6 tests from billet (c), 3 specimen from 1 location and 2 suppliers
9 tests from billet (d), 3 specimen from 3 locations and 1 supplier

(6) Same as note (5) except 5 tests from billet (a)

(7) 6 tests from each of billets (a), (b), and (c), 3 specimen from 1 location and 2 suppliers
3 tests from billet (d), 3 specimen from 1 location and 1 supplier

(8) 6 tests from billet (a), 3 specimen from 1 location and 2 suppliers
6 tests from billet (c), 3 specimen from 1 location and 2 suppliers
6 tests from billet (d), 6 specimen from 1 location and 1 supplier

(9) 6 tests from billet (a), 3 specimen from 1 location and 2 suppliers
6 tests from billet (b), 3 specimen from 1 location and 2 suppliers
3 tests from billet (d), 3 specimen from 1 location and 1 supplier

(10) All tensile modulus values from various locations, billets, and directions averaged

(11) All compressive modulus values from various locations, billets, and directions averaged

Table VIII - Continued

(1) 12 tests from billet (a), 3 specimen from 2 locations and 2 suppliers
18 tests from billet (b), 3 specimen from 3 locations and 2 suppliers
18 tests from billet (c), 3 specimen from 3 locations and 2 suppliers
9 tests from billet (d), 3 specimen from 3 locations and 1 supplier

(2) Same as note (1) except 20 tests from billet (c), 5 specimens from 2 locations and 2 suppliers

(3) 6 tests from billet (b), 3 specimen from 1 location and 2 suppliers
20 tests from billet (c), 5 specimen from 2 locations and 2 suppliers
3 tests from billet (d), 3 specimen from 1 location and 1 supplier

(4) Same as note (2) except 2 values from billet (c) dropped

(5) 6 tests from billet (a), 3 specimen from 1 location and 2 suppliers
18 tests from billet (b), 3 specimen from 3 locations and 2 suppliers
6 tests from billet (c), 3 specimen from 1 location and 2 suppliers
9 tests from billet (d), 3 specimen from 3 locations and 1 supplier

(6) Same as note (5) except 5 tests from billet (a)

(7) 6 tests from each of billets (a), (b), and (c), 3 specimen from 1 location and 2 suppliers
3 tests from billet (d), 3 specimen from 1 location and 1 supplier

(8) 6 tests from billet (a), 3 specimen from 1 location and 2 suppliers
6 tests from billet (c), 3 specimen from 1 location and 2 suppliers
6 tests from billet (d), 6 specimen from 1 location and 1 supplier

(9) 6 tests from billet (a), 3 specimen from 1 location and 2 suppliers
6 tests from billet (b), 3 specimen from 1 location and 2 suppliers
3 tests from billet (d), 3 specimen from 1 location and 1 supplier

(10) All tensile modulus values from various locations, billets, and directions averaged

(11) All compressive modulus values from various locations, billets, and directions averaged

Table X

SUMMARY OF AVERAGED TEST RESULTS FOR TENSILE SPECIMENS EXPOSED AT TEMPERATURE AND TESTED AT ROOM AND ELEVATED TEMPERATURE FOR ALL 2618-T61 BILLETS EVALUATED

Exposure Temp. (°F)	Exposure Time (Hr)	Test Temp. (°F)	Billet Direction	Ultimate Strength	Yield Strength	Elongation
250	10	RT	L	62.5	50.7	10.4
			LT	61.1	49.4	7.4
		250	L	57.9	48.1	11.9
			LT	57.9	48.4	9.3
250	100	RT	L	61.6	49.7	9.8
			LT	61.3	49.1	7.7
		250	L	57.9	47.7	12.4
			LT	58.0	47.4	8.7
250	1000	RT	L	62.7	50.9	10.4
			LT	62.6	51.9	7.1
		250	L	59.4	49.9	11.6
			LT	59.3	50.7	6.2
325	10	RT	L	62.4	50.9	9.4
			LT	61.3	50.3	7.2
		325	L	54.0	46.1	16.6
			LT	54.1	46.4	13.5
325	100	RT	L	63.4	53.3	8.3
			LT	62.4	52.1	7.0
		325	L	54.7	48.9	15.0
			LT	54.3	46.6	10.4
325	1000	RT	L	57.8	49.2	9.5
			LT	60.2	53.3	7.7
		325	L	49.6	44.9	14.0
			LT	53.2	49.1	10.4
400	10	RT	L	60.4	52.1	9.3
			LT	60.5	53.3	6.9
		400	L	45.1	40.7	16.0
			LT	44.4	41.2	16.5
400	100	RT	L	57.4	48.0	9.1
			LT	57.7	50.0	8.4
		400	L	43.1	38.9	15.6
			LT	43.5	40.0	13.0
400	1000	RT	L	51.3	39.6	10.1
			LT	51.2	40.3	9.1
		400	L	38.3	33.4	19.8
			LT	42.0	37.0	18.8

Table XI

FRACTURE TOUGHNESS, K_{IC}, PROPERTIES OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE, FROM SURFACE QUARTER-THICKNESS AND MID-THICKNESS OF 4" X 8" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billet (d)

Specimen	Billet Location	σ_{ys} (KSI)	Width (In)	Thickness (In)	Crack Length (In)	Gross Stress at Pop-in (KSI)	Net Fracture Stress (KSI)	K_{IC} KSI $\sqrt{IN}$	$\left(\frac{K_{IC}}{\sigma_{ys}}\right)^2$
8KSFL300	Surface		1.999	.250	.68	9.5	16.7	27.3	.323
8KSFL301	L	48.1	1.995	.252	.65	11.2	18.2	30.4	.399
8KSFL302			1.993	.252	.68	9.5	16.6	27.1	.317
Average								28.3	
8KSFT303	Surface		(1)	(1)	(1)	(1)	(1)	(1)	(1)
8KSFT304	LT	46.6	1.994	.249	.72	6.5	12.7	19.7	.179
8KSFT305			1.995	.250	.72	6.1	12.6	18.4	.156
Average								19.1	
8KQFL306	Quarter		2.001	.251	.68	8.7	15.5	24.6	.270
8KQFL307	Thick	47.3	1.995	.251	.65	11.0	17.0	29.9	.399
8KQFL308	L		1.997	.252	.63	11.8	18.4	30.9	.426
Average								28.5	
8KQFT309	Quarter		1.995	.251	.73	6.2	11.4	19.2	.176
8KQFT310	Thick	45.8	1.995	.250	.68	6.6	12.3	18.6	.165
8KQFT311	LT		2.000	.251	.69	6.7	11.6	19.1	.174
Average								19.0	
8KMFL312	Mid		1.996	.250	.68	10.4	20.4	29.8	.358
8KMFL313	Thick	49.8	1.995	.250	.67	10.3	19.9	29.0	.339
8KMFL314	L		1.995	.250	.64	11.2	20.1	29.7	.355
Average								29.5	
8KMFT315	Mid		2.000	.252	.67	9.5	16.6	26.4	.308
8KMFT316	Thick	47.6	2.000	.252	.69	8.9	17.1	24.0	.254
8KMFT317	LT		2.000	.253	.68	9.1	16.3	23.5	.244
Average								24.6	

(1) Failed during pre-cracking.

Table XII

STRESS CORROSION TEST RESULTS FOR AXIAL
LOADED SPECIMENS STRESSED TO 75% OF THEIR YIELD STRENGTH

Specimen	Supplier	Billet	Orientation	Hours Exposure	Remarks
6ARCL309		3 x 6-1/2		2016	No Failure
6ARCL310	A	(a)	L	2016	No Failure
6ARCL311				2016	No Failure
6ARCT312		3 x 6-1/2		122-137	Failed (1)
6ARCT313	A	(a)	LT	2016	No Failure
6ARCT314				75-115	Failed (1)
6ARCS315		3 x 6-1/2		75-115	Failed (1)
6ARCS316	A	(a)	ST	75-115	Failed (1)
6ARCS317				75-115	Failed (1)
6KRCL309		4 x 8		2016	No Failure
6KRCL310	K	(d)	L	2016	No Failure
6KRCL311				2016	No Failure
8KRCT312		4 x 8		75-115	Failed (1)
8KRCT313	K	(d)	LT	75-115	Failed (1)
8KRCT314				75-115	Failed (1)
8KRCS315		4 x 8		75-115	Failed (1)
8KRCS316	K	(d)	ST	75-115	Failed (1)
8KRCS317				75-115	Failed (1)

(1) Specimen failed during non-working hours between inspection periods.

Table XIII

STRESS CORROSION TEST RESULTS FOR
BEND SPECIMENS STRESSED TO 75% OF THEIR
YIELD STRENGTH

Specimen	Supplier	Billet	Orientation	Hours Exposure	Remarks
6ABCL1		3 x 6-1/2		2016	No Failure
6ABCL2	A	(a)	L	2016	No Failure
6ABCL3				2016	No Failure
6KBCL1		3 x 6-1/2		2016	No Failure
6KBCL2	K	(a)	L	2016	No Failure
6KBCL3				2016	No Failure
6ABCT4		3 x 6-1/2		2016	No Failure
6ABCT5	A	(a)	LT	2016	No Failure
6ABCT6				2016	No Failure
6KBCT4		3 x 6-1/2		120	Failed
6KBCT5	K	(a)	LT	194-209	Failed (1)
6KBCT6				146-161	Failed (1)
6ABCS7		3 x 6-1/2		290-305	Failed (1)
6ABCS8	A	(a)	ST	456-473	Failed (1)
6ABCS9				2016	No Failure
6KBCS7		3 x 6-1/2		80-96	Failed (1)
6KBCS8	K	(a)	ST	104-120	Failed (1)
6KBCS9				125	Failed
8KBCL301		4 x 8		2016	No Failure
8KBCL302	K	(d)	L	2016	No Failure
8KBCL30[illegible]				2016	No Failure
8KBCT303		4 x 8		2016	No Failure
8KBCT304	K	(d)	LT	2016	No Failure
8KBCT305				2016	No Failure
8KBCS306		4 x 8		75-115	Failed (1)
8KBCS307	K	(d)	ST	95	Failed
8KBCS308				460	Failed

(1) Specimen failed during non-working hours between inspection periods.

SECTION IV

SUPPLEMENTAL DATA

Since 2618 aluminum is presently not a widely used alloy, the data available from the literature and the suppliers is very limited. All data obtained from the suppliers was in the form of typical properties and not individually tabulated results.

One group of tabulated data was obtained from the Los Angeles Division of North American Aviation, Inc. These data were obtained from billets supplied by Canadian Steel Improvement, Ltd., who is associated with High Duty Alloys, Ltd., a British Company. The alloy, designated RR58 by the British, has approximately the same chemical composition as 2618. These data were for billet heat-treated to the T6 condition (80°F quench rather than boiling water to obtain the T61 condition). The data are reported in Appendix B, Tables LXXV through LXXIX. The properties of these billets were very similar to those obtained from the present study; however, elongations appeared slightly lower. These data were not included in the statistical evaluation for the "A" and "B" design values.

SECTION V

DISCUSSION

Design Property Variation: Comparison of the design mechanical property "A" values presently found in MIL-HDBK-5 with those determined during the present program shows the following: (1) the "A" values for ultimate tensile strength, F_{tu}, determined during the present program are one to two Ksi higher than those presently found in MIL-HDBK-5, while the "A" values for tensile yield strength, F_{ty}, are up to three Ksi lower than those presently found in MIL-HDBK-5; (2) elongation values presently found in MIL-HDBK-5 are zero to one percent (units) higher than those determined during this program; and (3) compression modulus values determined during this program are slightly lower than the value presently found in MIL-HDBK-5.

The "A" design values found in MIL-HDBK-5 are specification minimums and the data on which they are based (billet sizes, locations, etc.) are not readily available. In the present program a wide variation in billet sizes and test specimen locations from each billet and supplier were evaluated, and all of these data were assembled together to form one population for determination of the "A" and "B" values. This wide variation probably is one reason for some of the "A" values determined during this program being lower than those presently found in MIL-HDBK-5.

As shown in Table VIII the average values for yield strength and elongation for all billets evaluated exceeded the minimum values presently given in MIL-HDBK-5. Also, in studying the raw data, Tables XIV, XV, XVI and XVII, it is seen that the only individual yield strength test results that were actually lower than the minimum values presently found in MIL-HDBK-5 were a very few data points for billet (c), Table XVI, which was forged in an 8" x 11" section and subsequently reduced to a 4" x 8" section prior to heat treat, and a very few data points for billet (d), Table XVII. It is concluded, therefore, that all of the billets evaluated in this program met the present specification minimums for tensile properties; however, the statistical data shows that perhaps the minimums presently given in MIL-HDBK-5 are slightly high.

It is interesting to note the maximum spread in tensile test results from billet to billet and from mid-thickness to surface of each billet. Considering all tensile data it is seen that a maximum variation of up to 8 Ksi in ultimate strength and up to 10 Ksi in yield strength occurred. Comparison of average properties betwen billets showed that the 3" x 6½" billet had the highest properties while the 4" x 8" and 8" x 11" (reduced to 4" x 8" size for heat treat) had average properties quite similar and approximately three Ksi lower than the 3" x 6½" billet.

Thermal Stability: Exposure at 250°F for periods of time up to 1000 hours caused a very slight increase in room temperature ultimate tensile strength and up to a 5% increase in yield strength. Exposure at 325°F for up to 100 hours also caused slightly increased tensile and yield strengths at room temperature; however, after 1000 hours exposure at 325°F, tensile strength dropped approximately 5% while yield strength remained approximately equal to unexposed yield strength. At 400°F, exposure for up to 10 hours decreased the tensile strength a small amount but increased the yield strength approximately 5% as compared to the unexposed yield strength. Increasing reductions in both tensile and yield strength occurred after exposure at 400°F for increasing periods of time up to 1000 hours.

Similar increases and decreases as compared to room temperature unexposed properties occurred when tests were conducted at the exposure temperature (see Figures 21 through 24).

Increases in room temperature strength with long time exposure at 250°F and shorter exposure times at 325°F and 400°F indicates that the alloy is continuing to age. It is also generally noted that a decrease in elongation accompanies this increase in strength. This can be seen in Figure 30 where the 1000 hour exposure curve falls below the 10 and 100 hour curves at 250°F and 325°F. It would appear, therefore, that the additional aging causes a decrease in ductility.

Metallographic sections were removed from test specimens exposed at 325°F and 400°F for periods of time of 10, 100 and 1000 hours. The specimens exposed at 325°F are shown in Figure 48. Little difference in structure can be seen after 10 and 100 hours exposure; however, after 1000 hours exposure a great deal of precipitate is visible throughout the matrix. The magnification was increased to 1000X to photograph the structure because no structure definition could be obtained at the 250X magnification. The specimens exposed at 400°F are shown in Figure 49. Some additional precipitation in the matrix is noted after 10 hours exposure as compared to room temperature exposure, while considerably more is noted after 100 hour exposure. For the 1000 hour exposure the magnification had to again be increased to 1000X to obtain structure definition.

Fatigue Properties:

Axial Load: Unnotched axial fatigue test results were quite scattered for all billets evaluated. There appeared to be no definite trend for any one billet to be significantly better than another when compared on an overall basis. Notched material did not exhibit nearly as much scatter as unnotched, perhaps because the notch effect masked any detrimental effect which the unnotched material experienced. Endurance limit of the unnotched material (based on 10^7 cycles) was quite high. For all billets the endurance limit exceeded 50% of the ultimate strength of the material and for some billets it was nearly two-thirds of the ultimate strength.

Rotating Beam: Very little scatter occurred in notched and unnotched rotating beam fatigue properties of material removed from the surface, quarter-thickness and mid-thickness of 4" x 8" billet (b).

Unnotched properties determined at 250°F fell on the low end or within the room temperature scatter band, except for the endurance limit area (10^7 cycles) where the 250°F applied stress required lowering to 5 to 10 Ksi to obtain the same lifetime as at room temperature. Properties determined at 400°F generally fell slightly below the 250°F properties; however, the endurance limit (10^7 cycles) appeared to be approximately the same as at 250°F.

Notched properties at 250°F generally fell completely within the room temperature scatter band except in the endurance limit area. At 400°F the notched test data fell on the bottom edge of the room temperature scatter band and the endurance limit appeared to be almost equal to the room temperature endurance limit.

Notched Properties: It is significant to note that in the notched to unnotched strength plots, Figures 33 through 36, the general trend was for increased ductility when going from surface to mid-thickness material. Also, the ductility of the smaller 3 x 6½ inch billet was the lowest, followed by the 4 x 8 inch billet, with the 8 x 11 inch billet generally having the best ductility.

Fracture Toughness: Distinct pop-in occurred for all fracture toughness tests conducted. Typical load-deformation curves obtained for longitudinal and long transverse test specimens removed from surface material are shown in Figure 50. No deviation from linearity in the load-deformation curves occurred prior to pop-in; however, the validity of the test results might now be considered questionable if the latest recommendations of certain members of ASTM Committee E-24 are strictly complied with. These recommendations, which were discussed at the 69th Annual ASTM Meeting, June 1966, suggest that both the crack length and thickness of the test specimen exceed the ratio of $(K_{IC}/\sigma_{ys})^2$ by a factor of 2 to 3 if valid toughness values are to be obtained. As shown in Table XI some of the ratios of $(K_{IC}/\sigma_{ys})^2$ for the data generated in this program exceeded the specimen thickness, while some were less.

Little difference was noted in longitudinal toughness of specimens removed from mid-thickness, quarter-thickness and surface material. However, it is significant to note that the mid-thickness long transverse material had considerably higher toughness than the quarter-thickness and surface material.

The literature contains very little fracture toughness data on forged material with which the present data can be compared. One evaluation, Reference 4, in which 7001-T75, 7075-T6 and 7079-T6 hand forged billet was evaluated, can be used for comparison; however, it should be noted that these data are for 1¼ x 4 inch billet compared to the

4 x 8 inch billet used to evaluate the 2618. Comparison of these data show that 2618 has toughness similar to 7075-T6 in the longitudinal direction. In the long transverse direction the 2618 had similar toughness in the mid-thickness area; however, in the surface and quarter-thickness areas of the 2618 the toughness was lower than that reported for 7075-T6.

Stress Corrosion Properties: Stress corrosion tests indicated that 2618 is susceptible to stress corrosion cracking in the long and short transverse directions when stressed to 75% of its yield strength. No failures occurred in the longitudinal direction after 12 weeks of alternate immersion exposure.

Failure of specimens removed in the long transverse direction occurred in as short a time as four days, while some specimens did not fail after 12 weeks exposure. Typical microstructure of a specimen which showed no apparent failure after 12 weeks and a specimen which failed after five days is presented in Figure 51. The cracks which are evident on the specimen exposed for 12 weeks could not be seen on a macro scale because of the thick layer of accumulated salt on the test surface.

Cracks typical of those found in specimens tested in the short transverse direction are shown in Figure 52, while a section typical of the surface of a specimen removed in the longitudinal direction is shown in Figure 53. Considerable pitting can be seen in the longitudinal direction; however, no cracking occurred.

SECTION VI

CONCLUSIONS AND RECOMMENDATIONS

The hand forged 2618-T61 billets evaluated during this program were found to retain elevated temperature mechanical properties very well. For example, at 250°F design properties were reduced approximately 5 percent, while at 325°F and 400°F reductions of approximately 10 and 20 percent respectively were noted. Due to its good elevated temperature strength, it appears feasible to use this alloy at temperatures above 400°F for short periods of time. Therefore, it is recommended that additional studies be conducted to determine design values at temperatures above 400°F.

An increase in room temperature tensile properties of up to 6 percent was found to occur after the following thermal exposures: 1000 hours at 250°F, up to 100 hours at 325°F, and up to 10 hours at 400°F. It was generally noted also that decreases in elongation accompany this increasing strength, indicating that the ductility is decreasing with the additional aging. Consequently, it is recommended that additional studies be conducted to determine the amount of this ductility reduction.

Applied stresses exceeding the yield strength were required for appreciable creep deformation to occur at 250°F, while stresses of approximately 75 and 50 percent of the yield strength at temperature were required for 1% creep to occur in 1000 hours at 325°F and 400°F.

Fatigue endurance limit (based on 10^7 cycles) of axial load tension-tension specimens exceeded 50 percent of the ultimate tensile strength for all billets evaluated.

Rotating beam fatigue properties at 250°F fell within or at the lower end of the room temperature scatter band. At 400°F the fatigue properties fell slightly below the 250°F properties, however, the endurance limit (10^7) appeared to be approximately the same as at 250°F.

Plane strain fracture toughness at all areas in the billet in the longitudinal direction and at the mid-thickness area in the long transverse direction was similar to 7075-T6; however, the quarter-thickness and surface areas of the billet in the long transverse direction generally had lower fracture toughness than most data reported for 7075-T6. Recent recommendations by members of ASTM Committee E-24 at the 69th Annual ASTM Meeting suggest that the thickness of the fracture toughness specimen and the crack length exceed the ratio of $(K_{IC}/\sigma_{ys})^2$ by factor of 2 to 3. This was not the case for the tests conducted during this program. Pop-in occurred for all tests and no deviation from linearity in the load-deformation

curve occurred indicating that valid results were obtained; however, it is recommended that additional fracture toughness studies be conducted using larger specimens to determine if the present results are valid. It is also recommended that additional studies be conducted on other 2618 billets to determine what variability might be encountered from billet to billet.

It was determined that 2618-T61 is susceptible to stress corrosion cracking in the two transverse directions. Longitudinal test specimens stressed to 75% of their yield strength did not fail after 12 weeks of alternate immersion testing in 3½% NaCl. However, approximately half of the long transverse specimens stressed to 75% of their yield strength failed over the time period of 4 to 8 days while the remaining specimens did not fail. All of the short transverse specimens stressed to 75% yield failed over the time period of 4 to 20 days.

It is recommended that additional stress corrosion studies be conducted at various sustained stress levels to determine the threshold stress required for no failures to occur in the transverse directions.

REFERENCES

(1) J.E. Srawley, M.H. Jones, B.Gross, "Experimental Determination of the Dependence of Crack Extension Force on Crack Length for a Single-Edge-Notch Tension Specimen", NASA TN D-2396, August 1964.

(2) B. Gross, J.E. Srawley, W.F. Brown, "Stress Intensity Factors for a Single-Edge-Notch Tension Specimen by Boundry Collocation of a Stress Function", NASA TN D-2696, August 1964

(3) Internal Communication, Los Angeles Division, North American Aviation, Inc.

(4) S.O. Davis, N.G. Tupper, R.M. Niemi, "Plane Strain Fracture Toughness Properties of Three Aluminum Alloys as a Function of Specimen Geometry", AFML-TR-65-150, July 1965

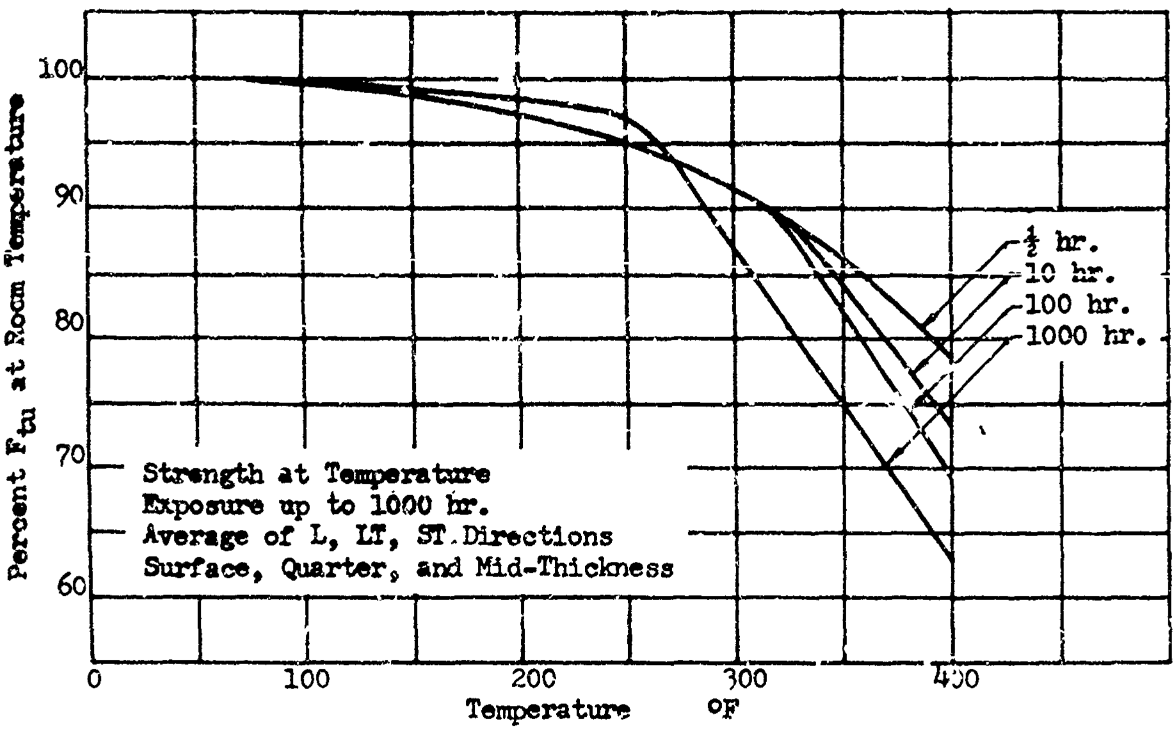


FIGURE 21

Effect of Temperature on the Ultimate Tensile Strength (F_{tu}) of 2618 -T61 Aluminum Forgings

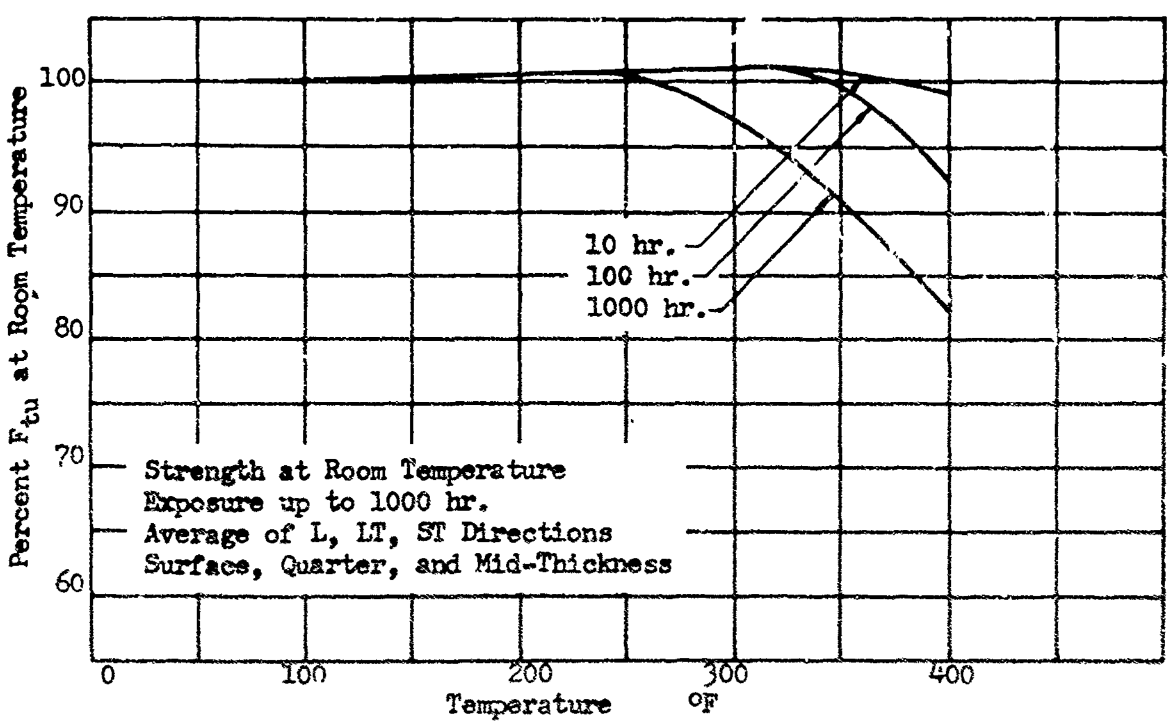


FIGURE 22

Effect of Exposure at Elevated Temperatures on the Room Temperature Ultimate Tensile Strength (F_{tu}) of 2618 -T61 Aluminum Forgings

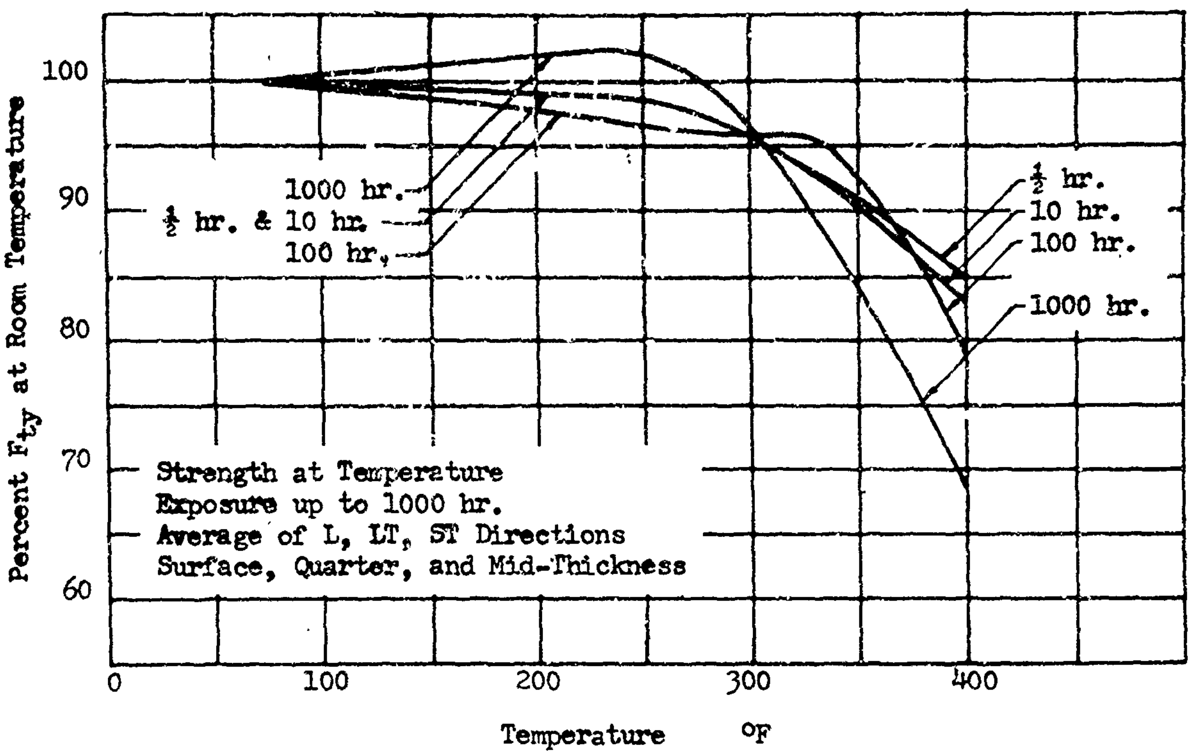


FIGURE 23

Effect of Temperature on the Tensile Yield Strength (F_{ty}) of 2618 -T61 Aluminum Forgings

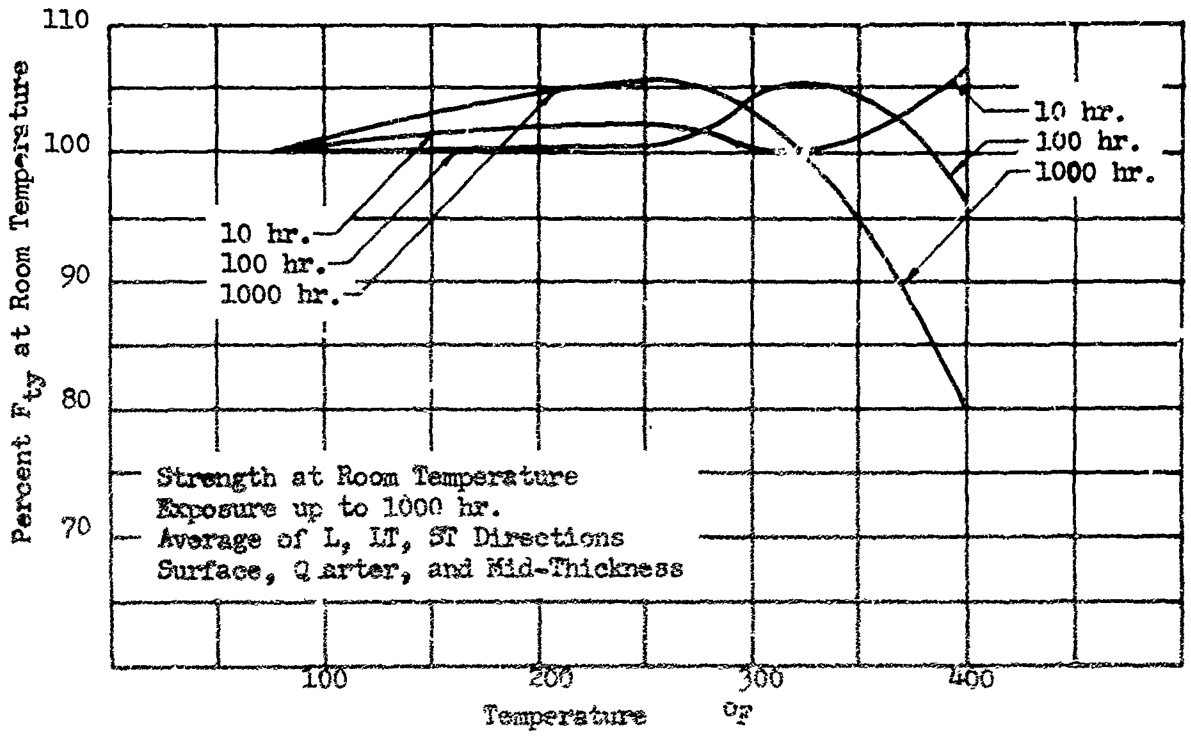


FIGURE 24

Effect of Exposure at Elevated Temperatures on the Room Temperature Yield Strength (F_{ty}) of 2618 -T61 Aluminum Forgings

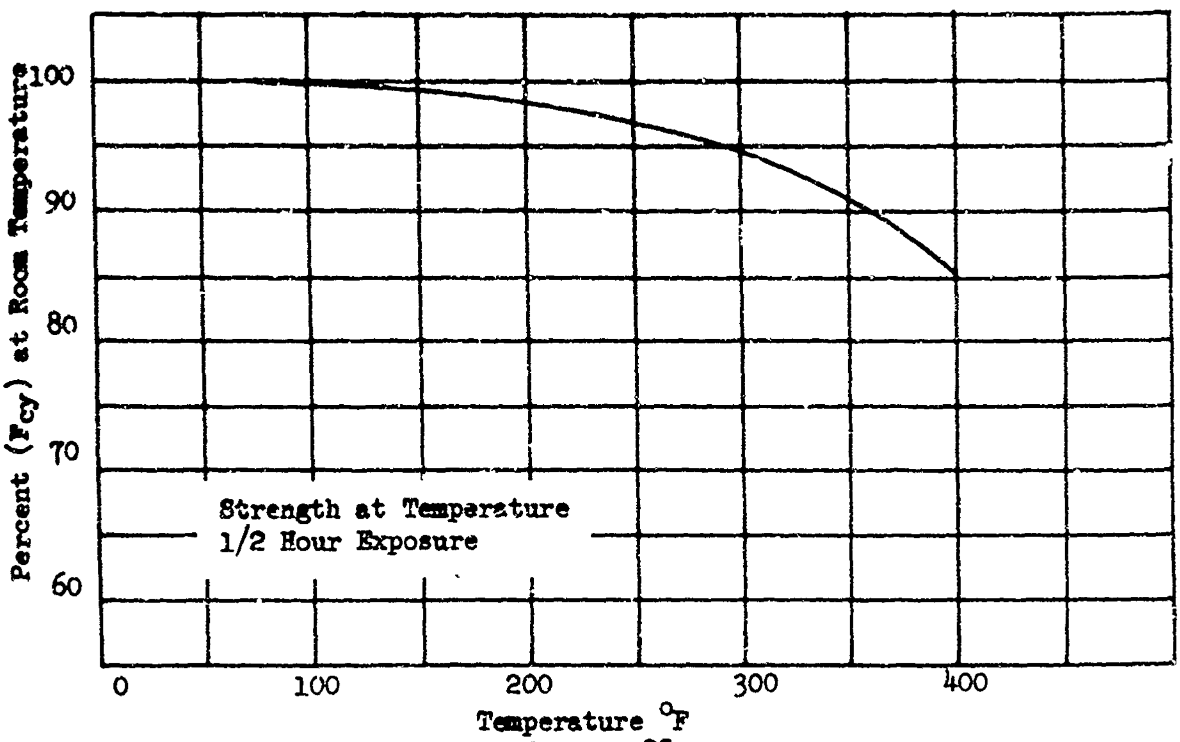


Figure 25

Effect of Temperature on the Compressive Yield Strength (F_{cy}) of 2618-T61 Aluminum Forgings

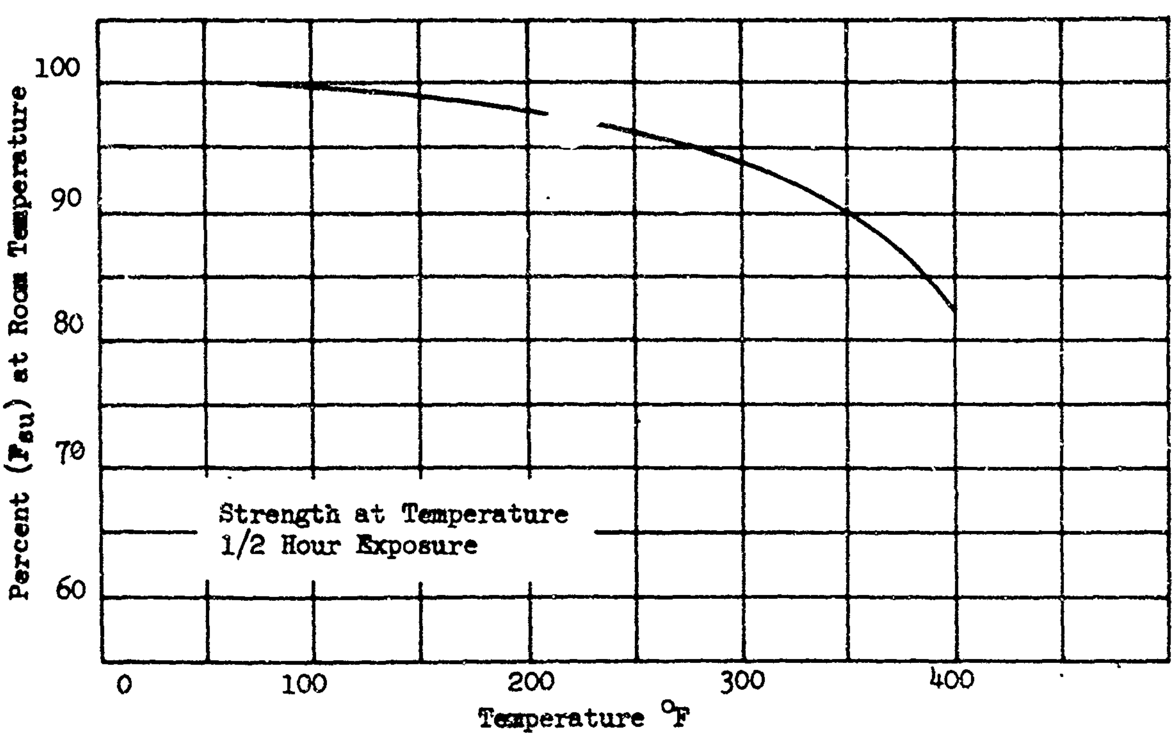


Figure 26

Effect of Temperature on the Ultimate Shear Strength (F_{su}) of 2618-T61 Aluminum Forgings

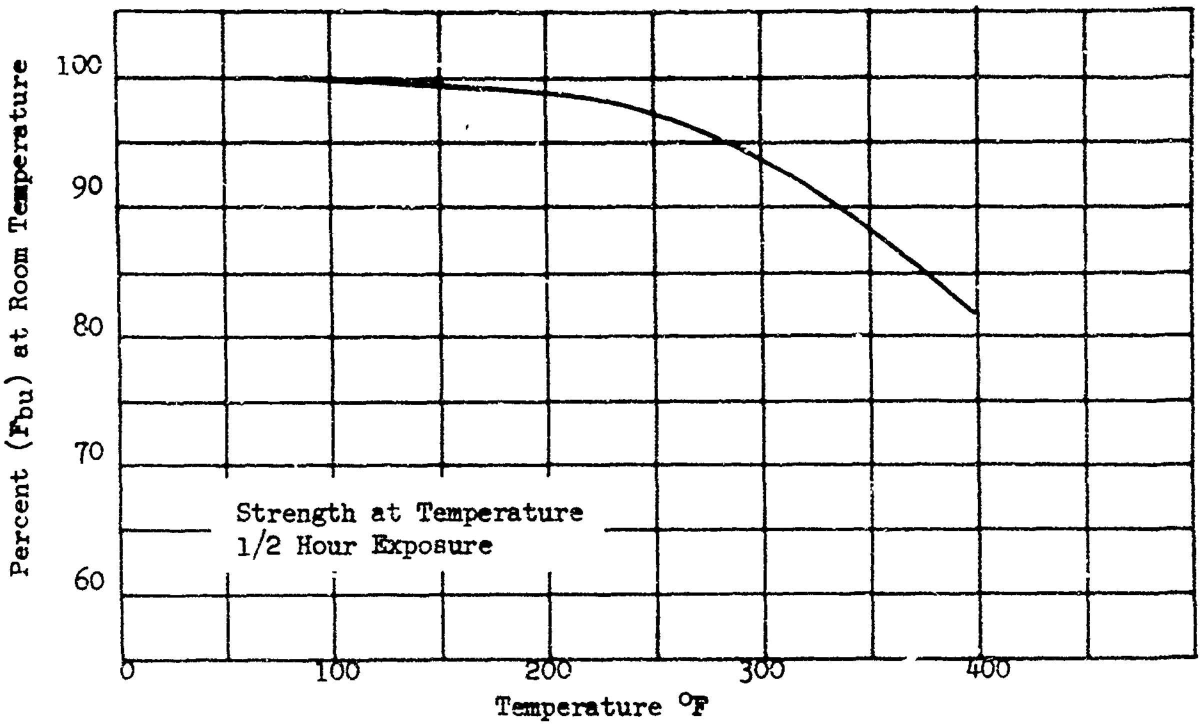


Figure 27

Effect of Temperature on the Ultimate Bearing Strength (F_{bu}) of 2618-T61 Aluminum Forgings, e/D=2.0

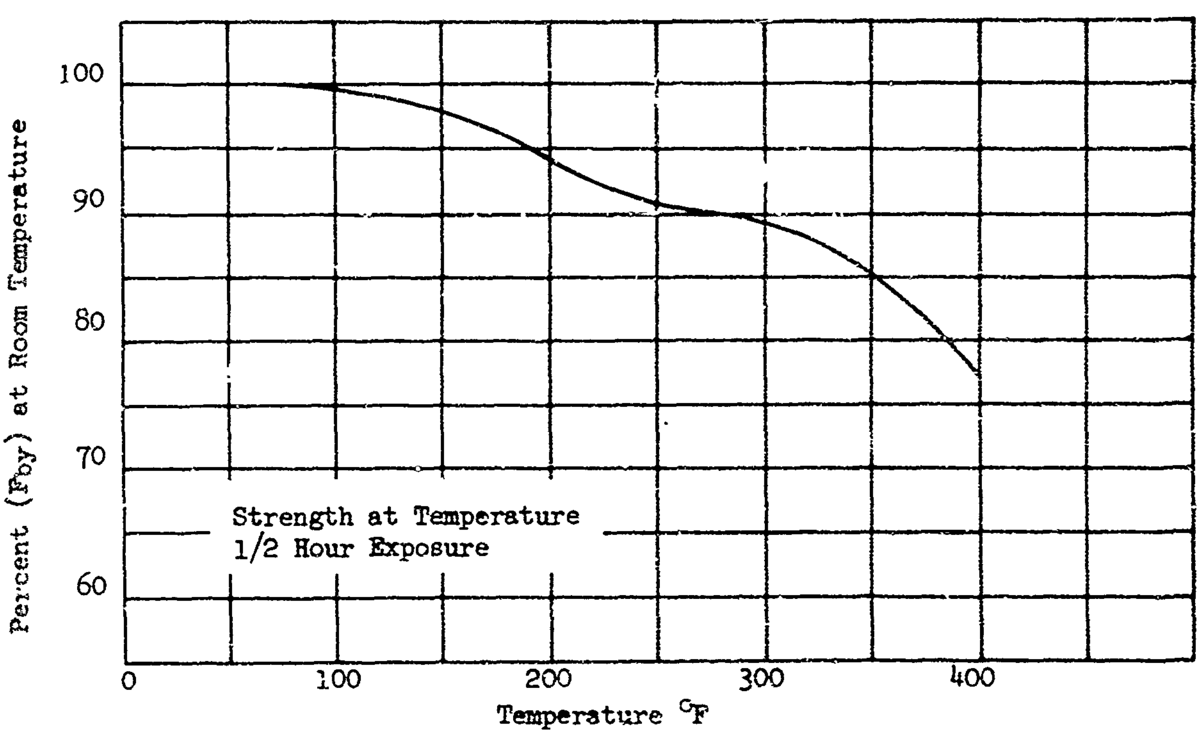


Figure 28

Effect of Temperature on the Bearing Yield Strength (F_{by}) of 2618-T61 Aluminum Forgings, e/D=2.0

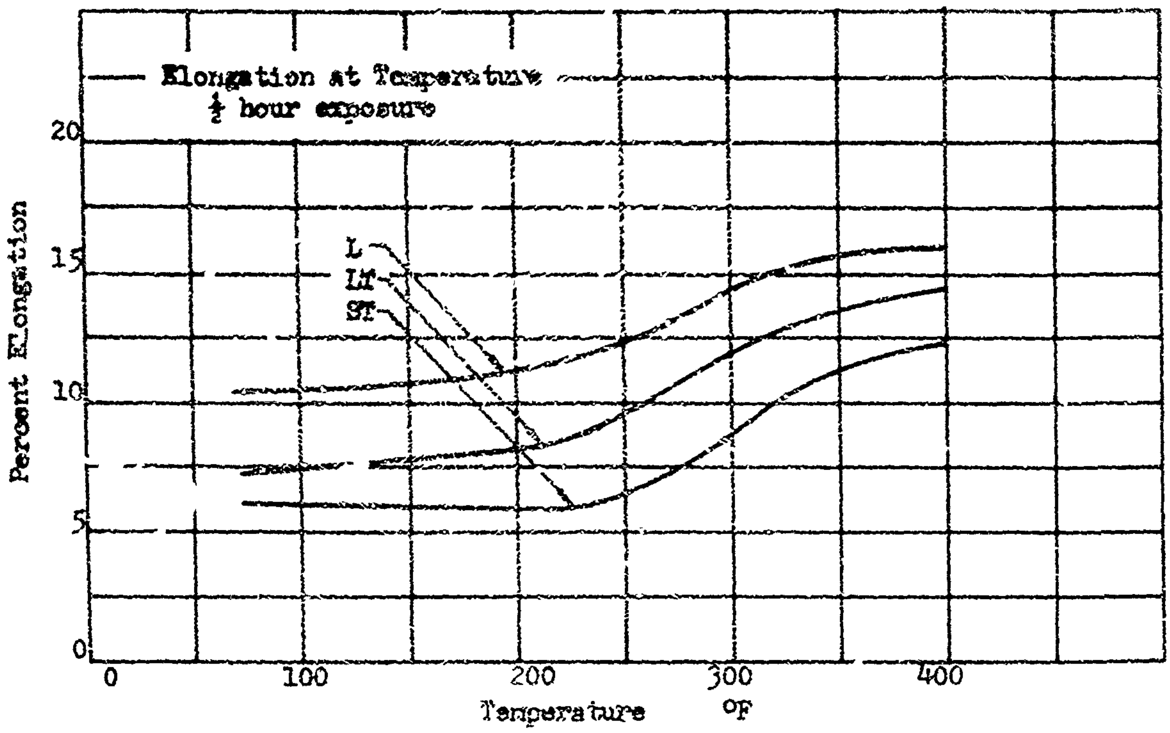


FIGURE 29

Effect of Temperature on the Elongation of 2618 -T61 Aluminum Forgings

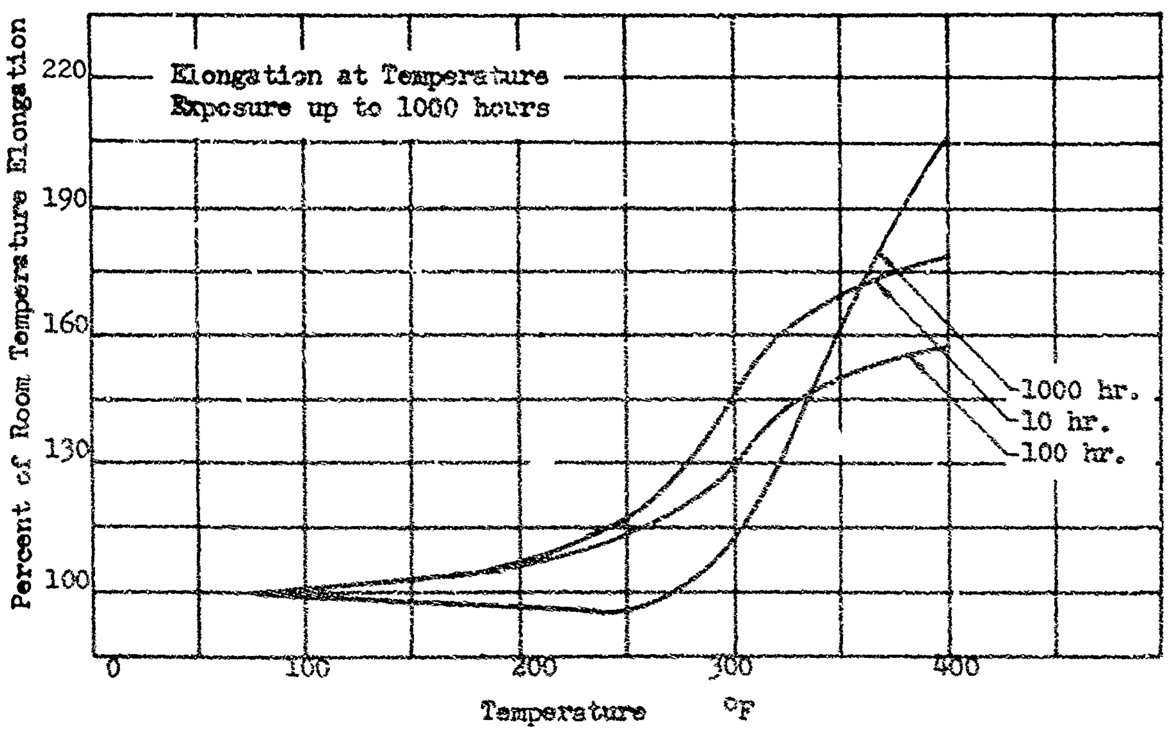


FIGURE 30

Effect of Exposure at Elevated Temperature on the Elongation of 2618 -T61 Aluminum Forgings

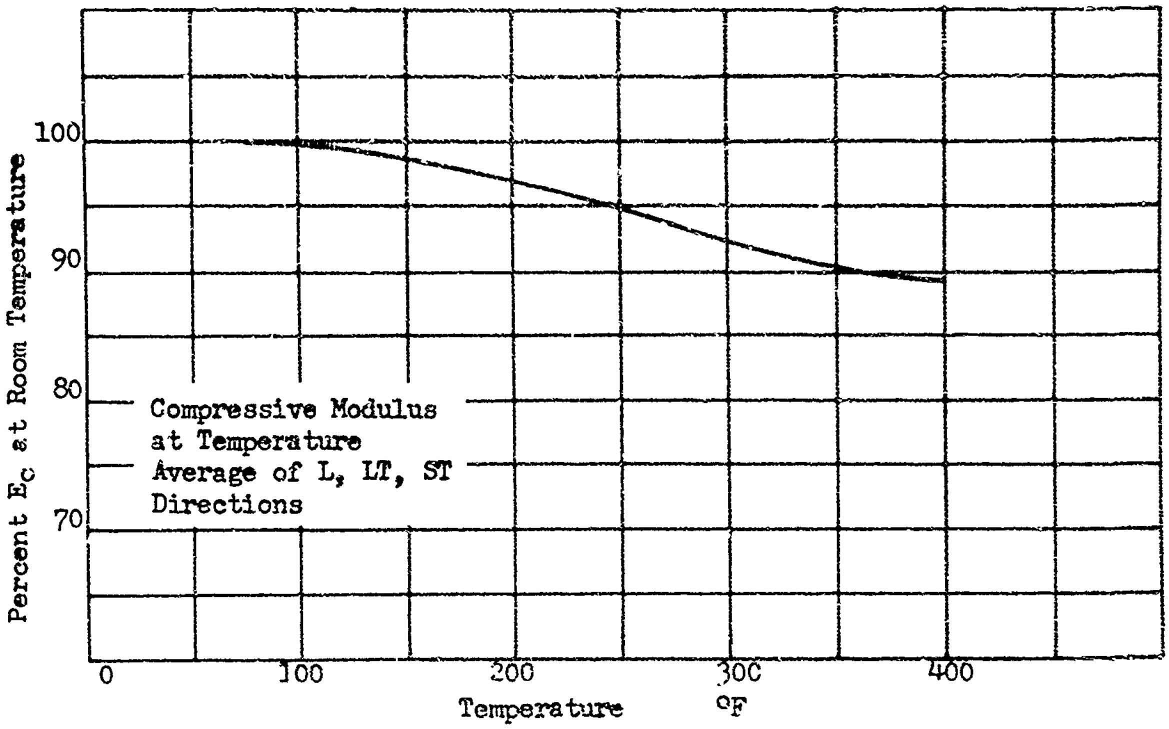


FIGURE 31

Effect of Temperature on the Compressive Modulus (E_c)
of 2618 -T61 Aluminum Forgings

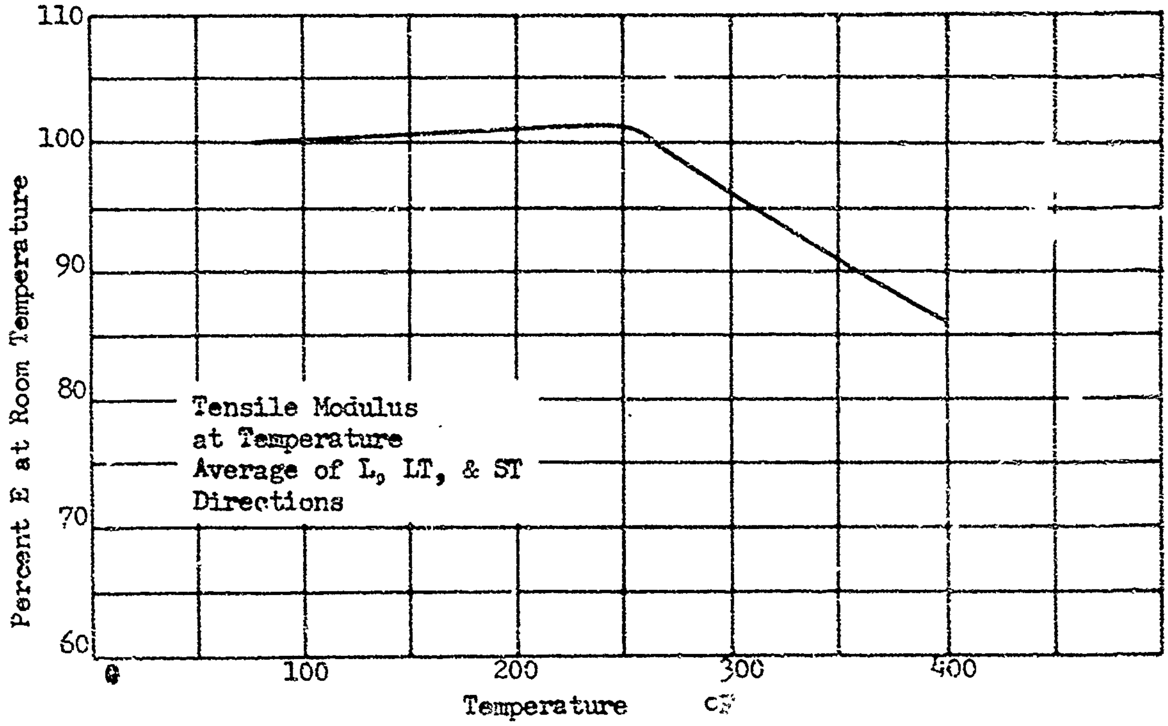


FIGURE 32

Effect of Temperature on the Tensile Modulus (E)
of 2618 Aluminum Forgings

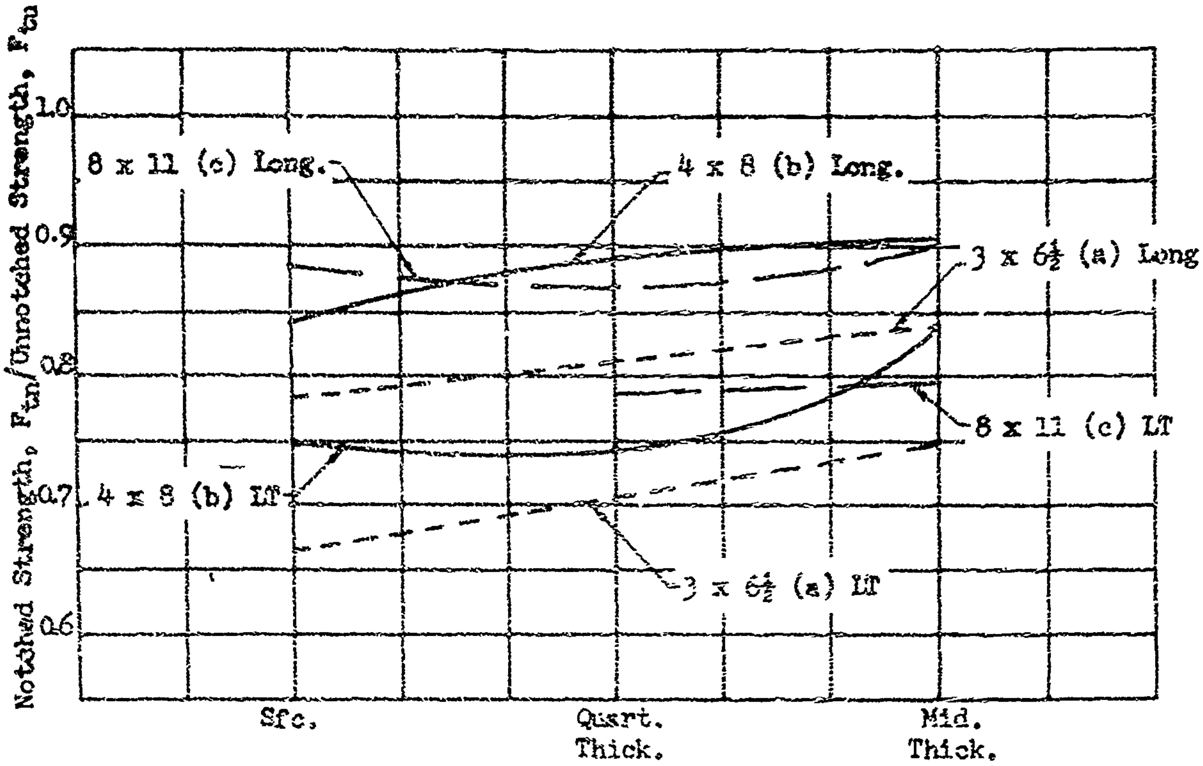


FIGURE 33

Notched Strength at Room Temperature of 2618 Aluminum Forgings From Various Billet Locations

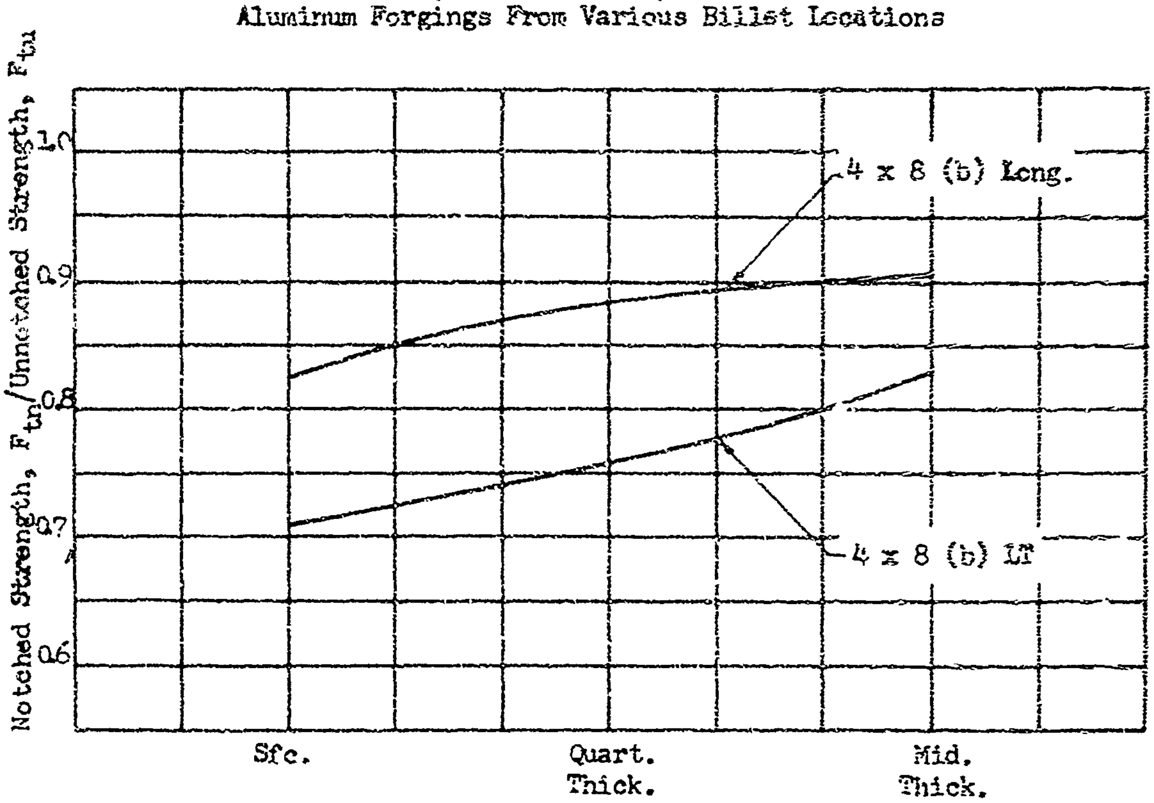


FIGURE 34

Notched Strength at 250°F of 2618 Aluminum Forgings From Various Billet Locations

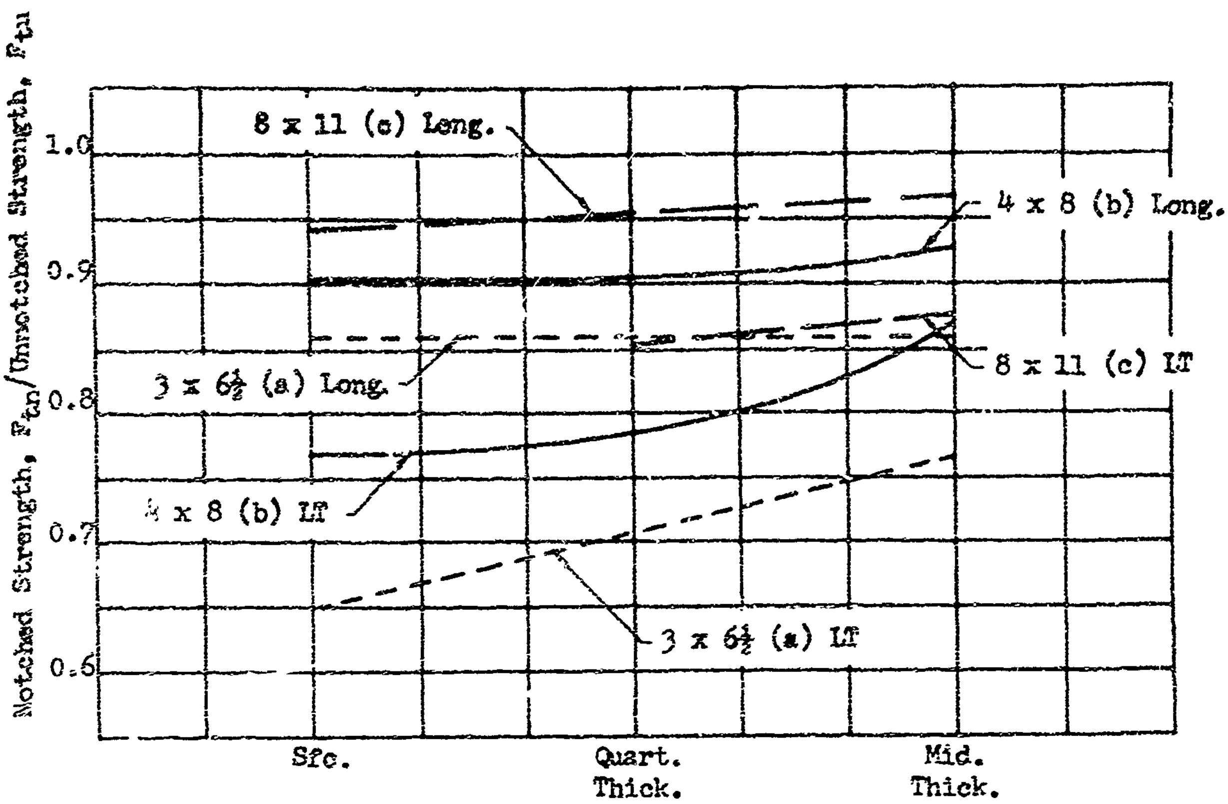


FIGURE 35

Notched Strength at 325°F of 2618 Aluminum
Forgings Versus Billet Location

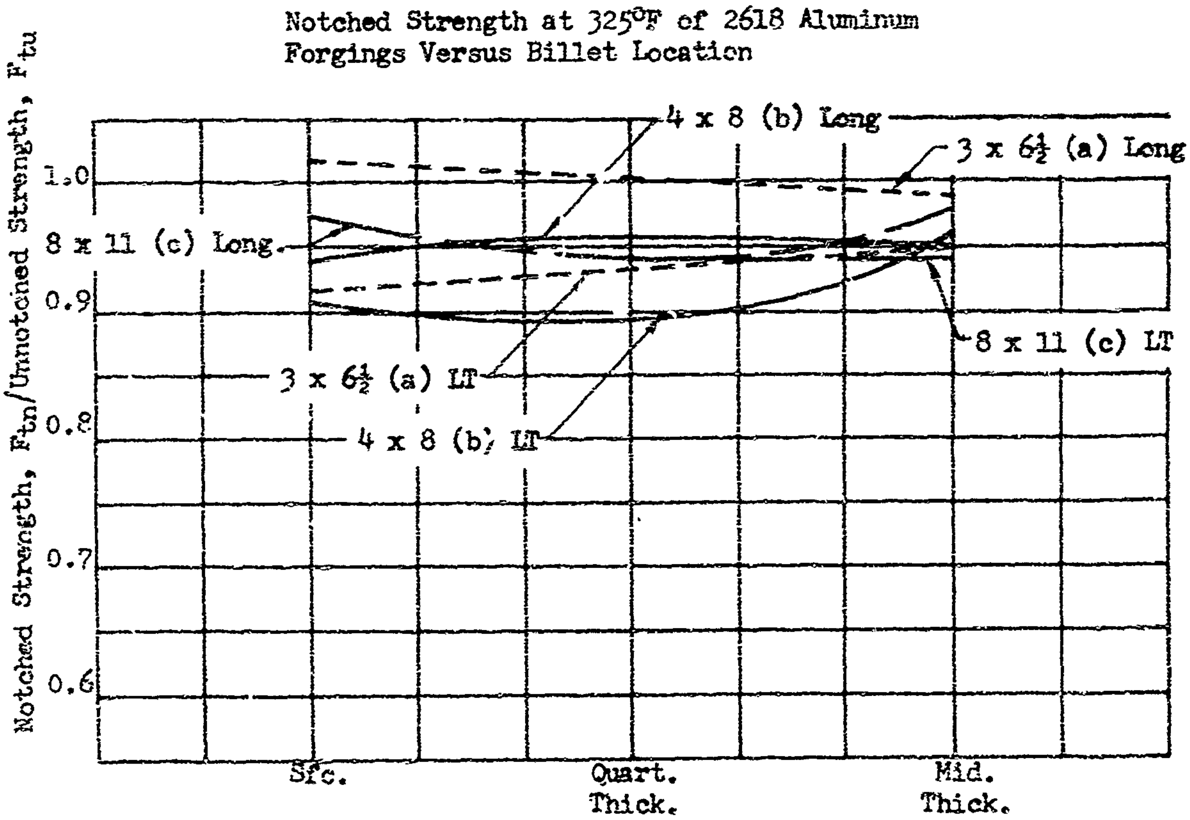


FIGURE 36

Notched Strength at 400°F of 2618 Aluminum
Forgings Versus Billet Location

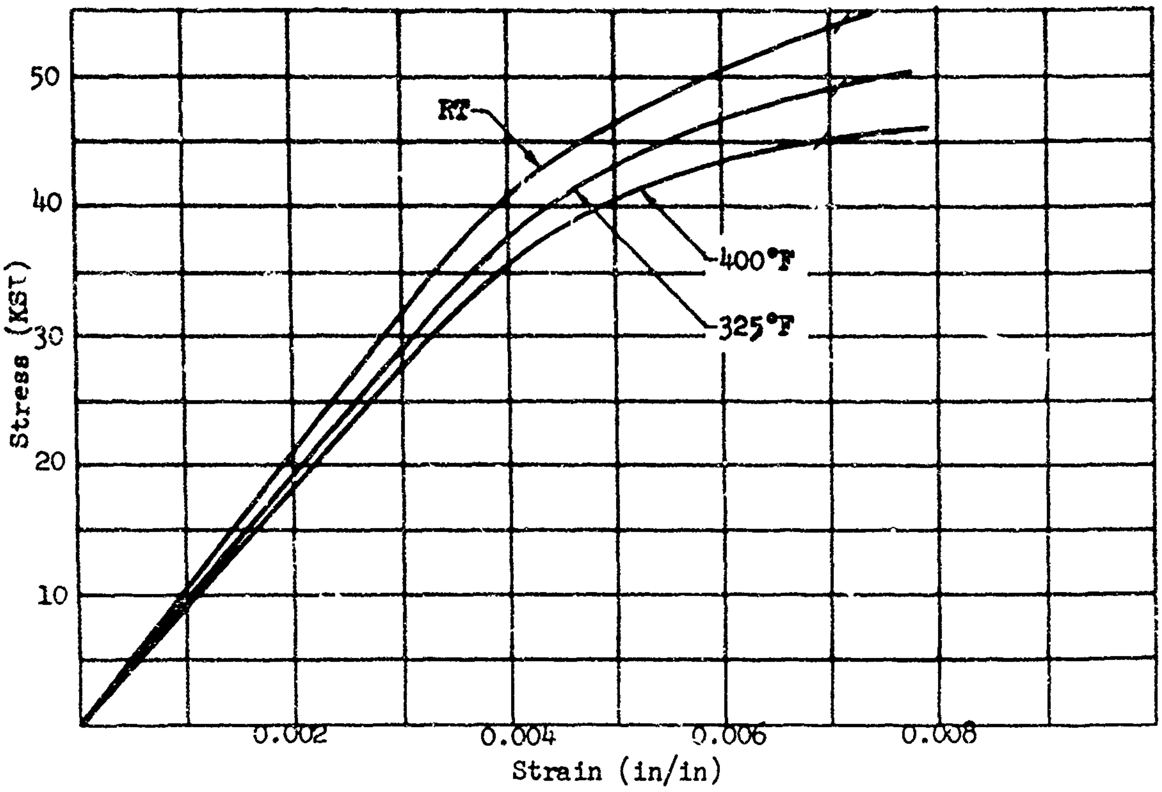


FIGURE 37
Typical Compressive Stress-Strain Curves at Room and Elevated Temperatures for 2618 Aluminum Forgings

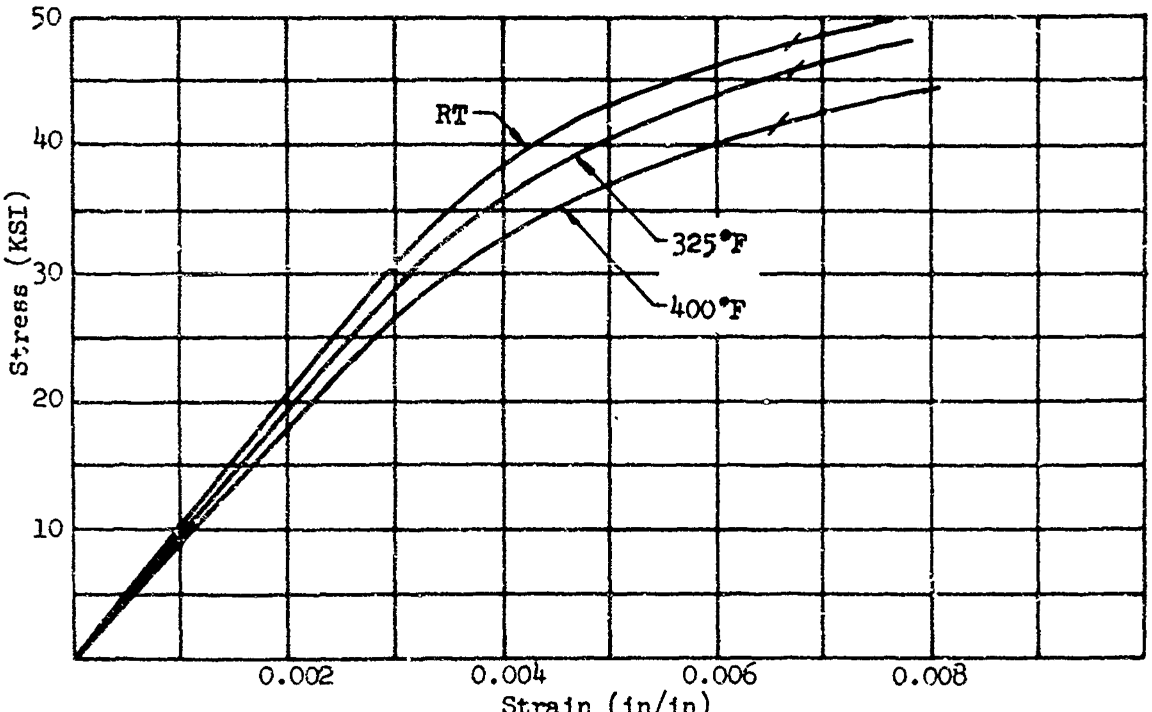


FIGURE 38
Typical Tensile Stress-Strain Curves at Room and Elevated Temperatures for 2618 Aluminum Forgings

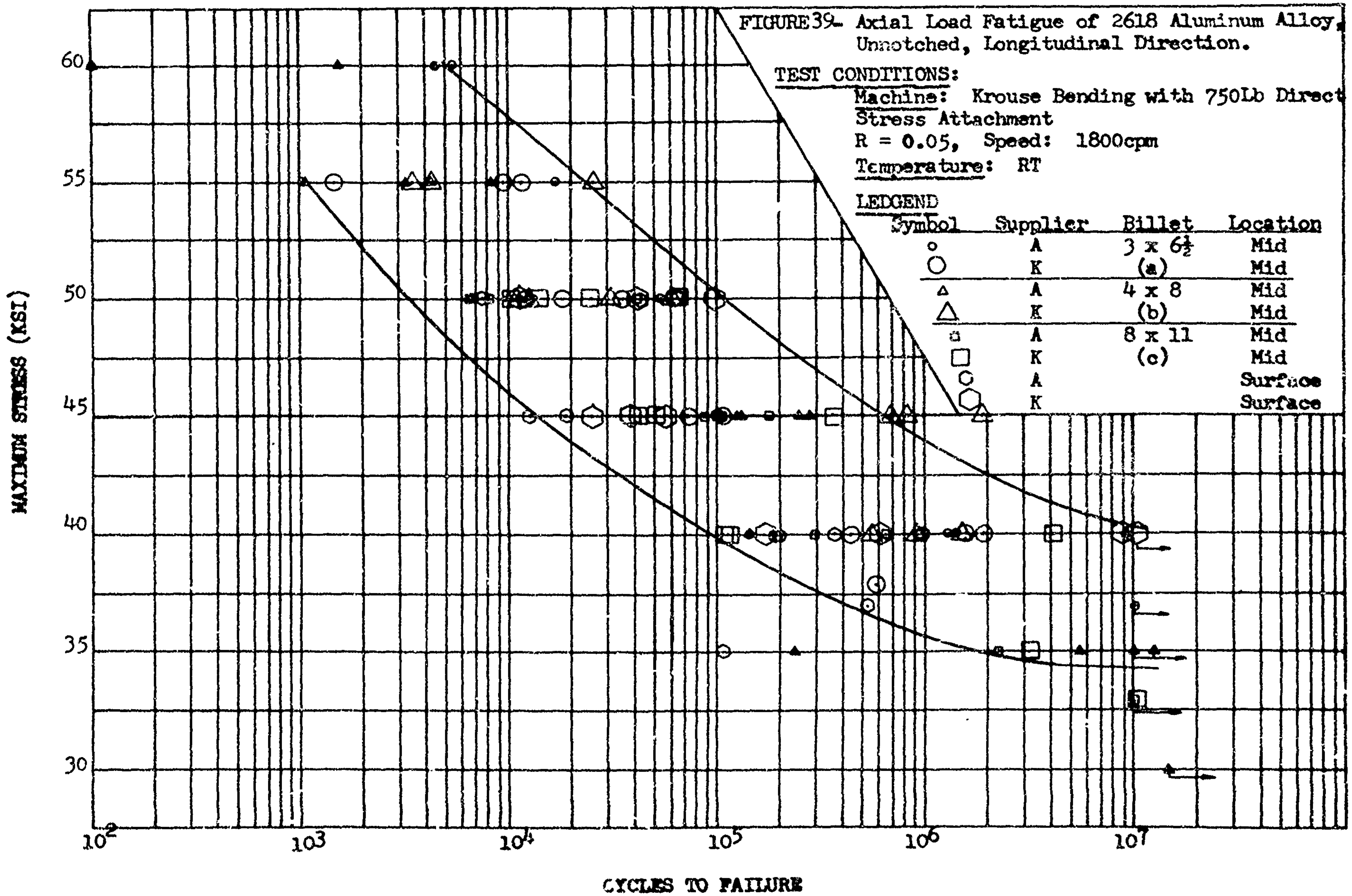


FIGURE 39- Axial Load Fatigue of 2618 Aluminum Alloy, Unnotched, Longitudinal Direction.

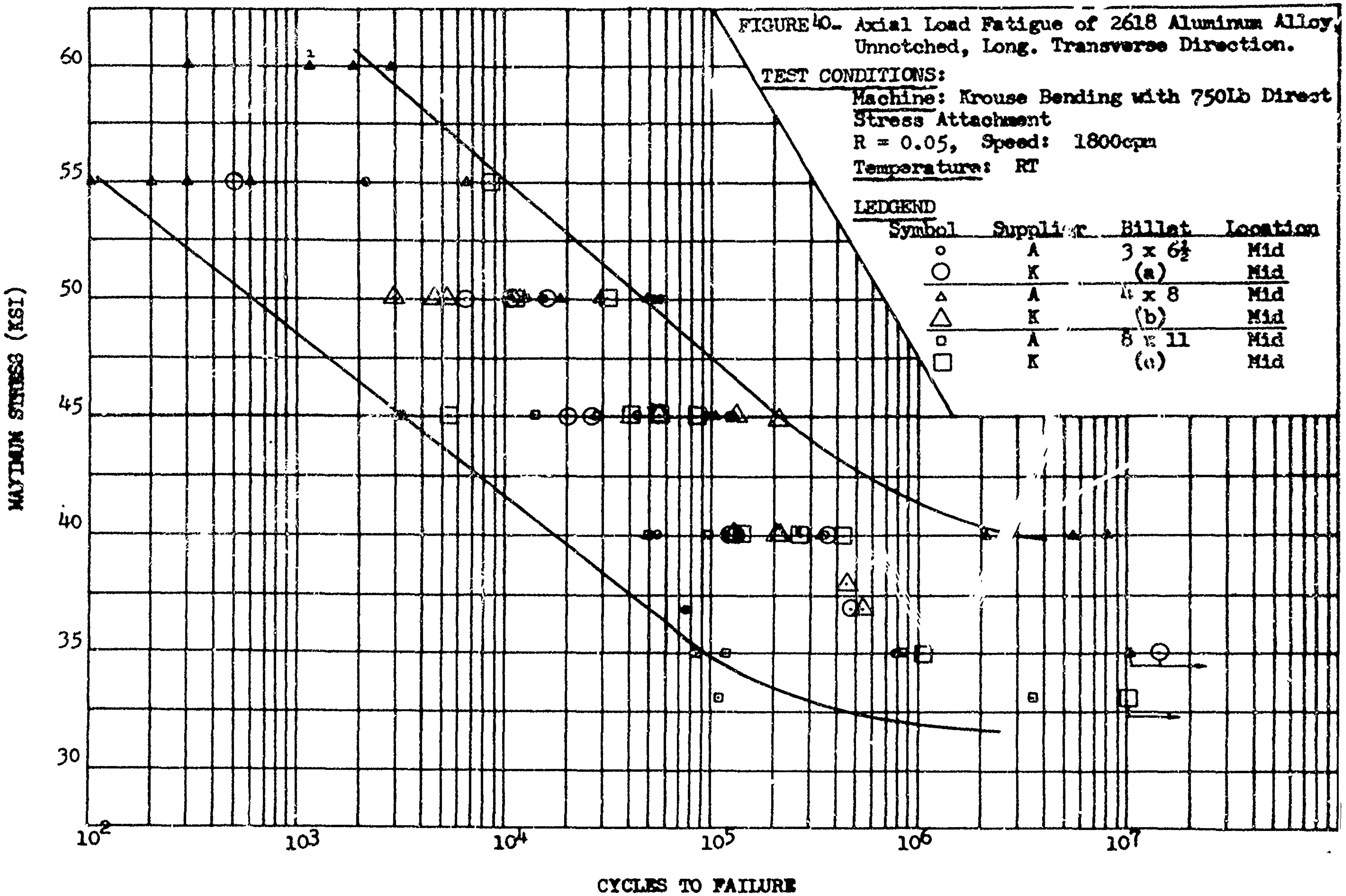


FIGURE 40. Axial Load Fatigue of 2618 Aluminum Alloy, Unnotched, Long. Transverse Direction.

TEST CONDITIONS:

Machine: Krouse Bending with 750Lb Direct Stress Attachment

R = 0.05, Speed: 1800cpm

Temperature: RT

LEDGEND

Symbol	Supplier	Billet	Location
○ (small)	A	3 x 6½	Mid
○	K	(a)	Mid
△ (small)	A	4 x 8	Mid
△	K	(b)	Mid
□ (small)	A	8 x 11	Mid
□	K	(c)	Mid

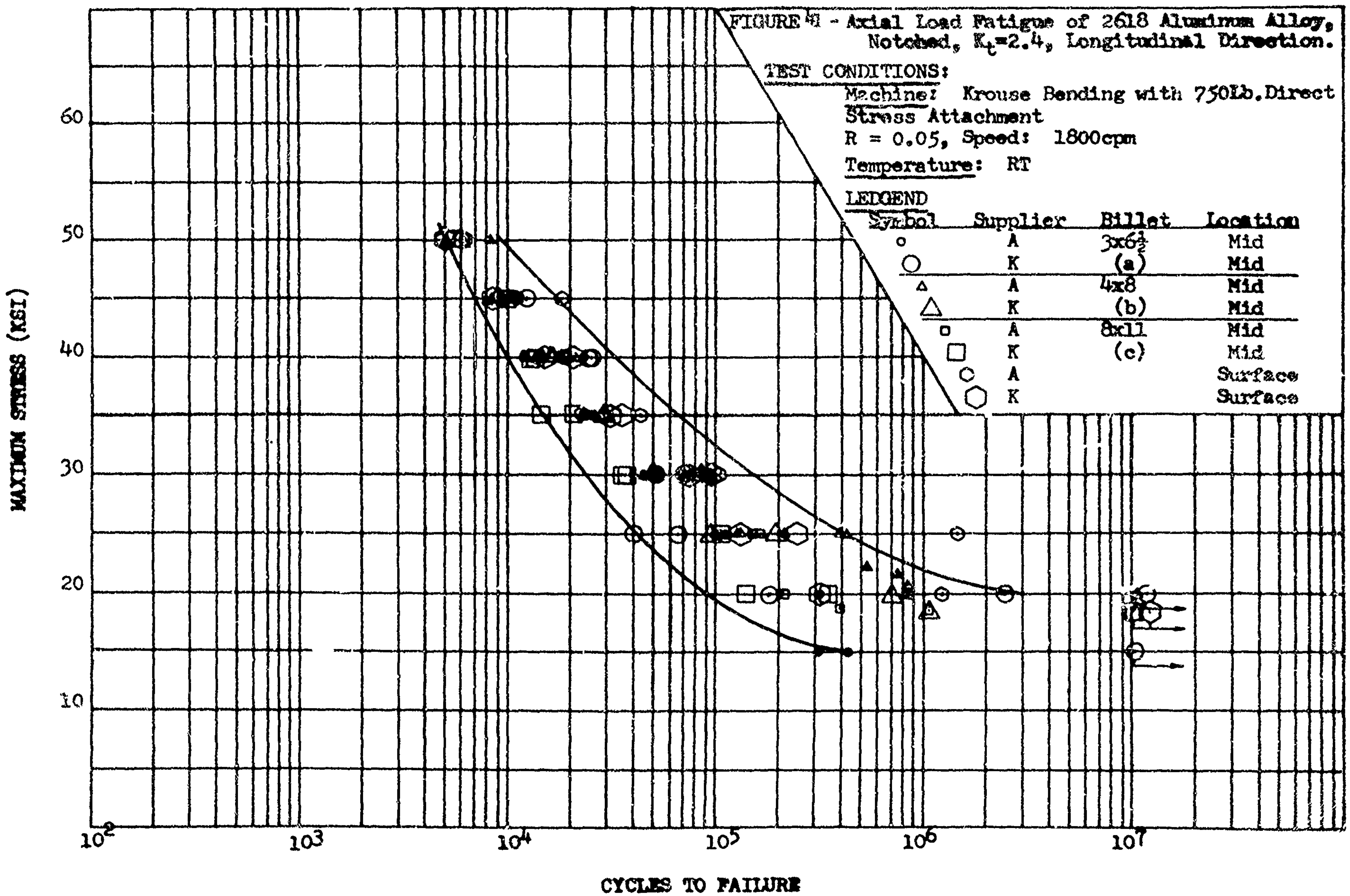


FIGURE 41 - Axial Load Fatigue of 2618 Aluminum Alloy, Notched, K_t=2.4, Longitudinal Direction.

TEST CONDITIONS:
Machine: Krouse Bending with 750Lb. Direct Stress Attachment
R = 0.05, Speed: 1800cpm
Temperature: RT

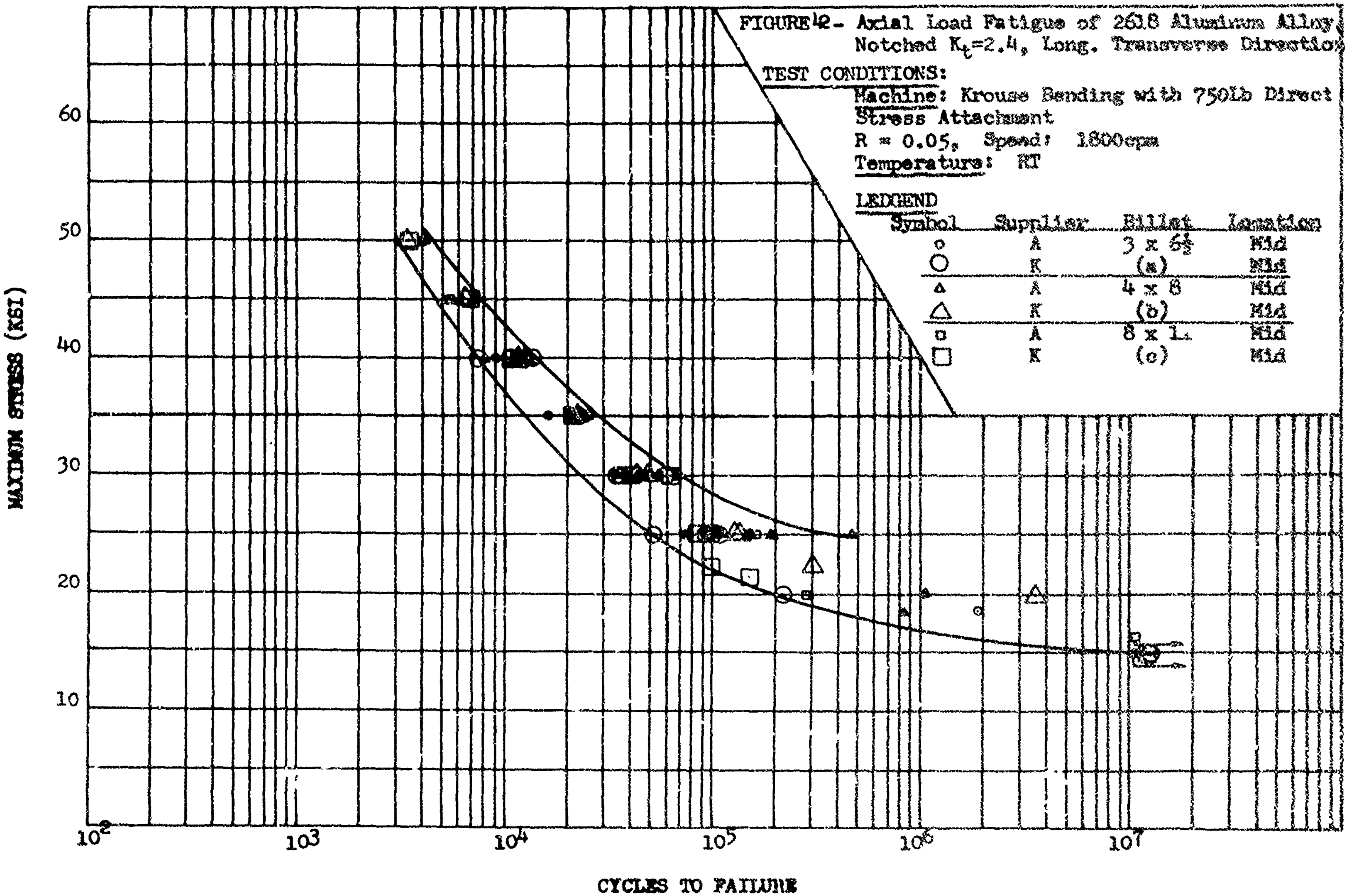


FIGURE 12 - Axial Load Fatigue of 2618 Aluminum Alloy, Notched K_t=2.4, Long. Transverse Direction

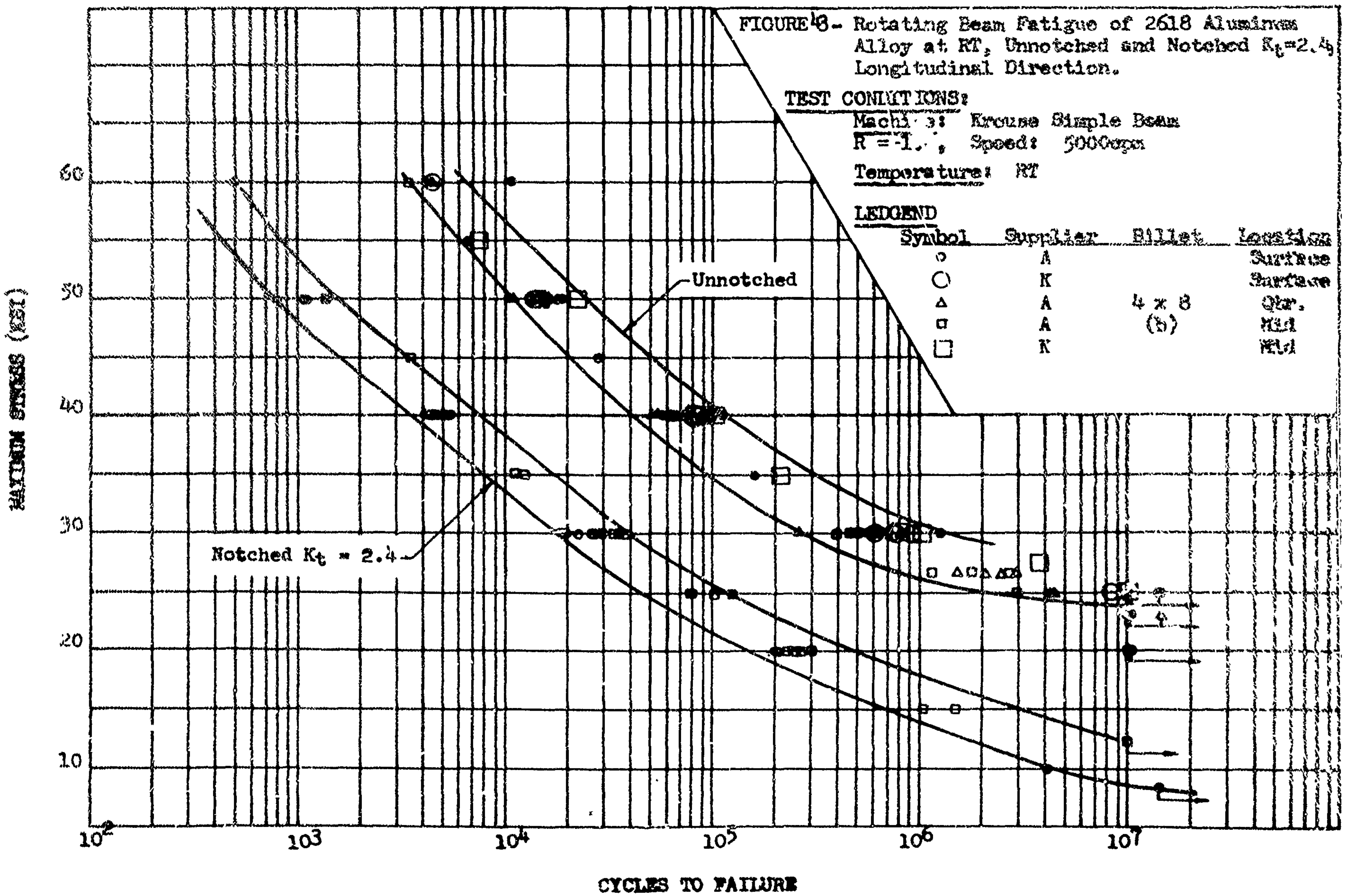


FIGURE 18 - Rotating Beam Fatigue of 2618 Aluminum Alloy at RT, Unnotched and Notched K_t=2.4, Longitudinal Direction.

TEST CONDITIONS:
Machine: Krouse Simple Beam
R = -1.0, Speed: 5000cpm
Temperature: RT

LEDGEND

Symbol	Supplier	Billet	Location
○	A		Surface
◯	K		Surface
△	A	4 x 8	Qtr.
□	A	(b)	Mid
☐	K		Mid

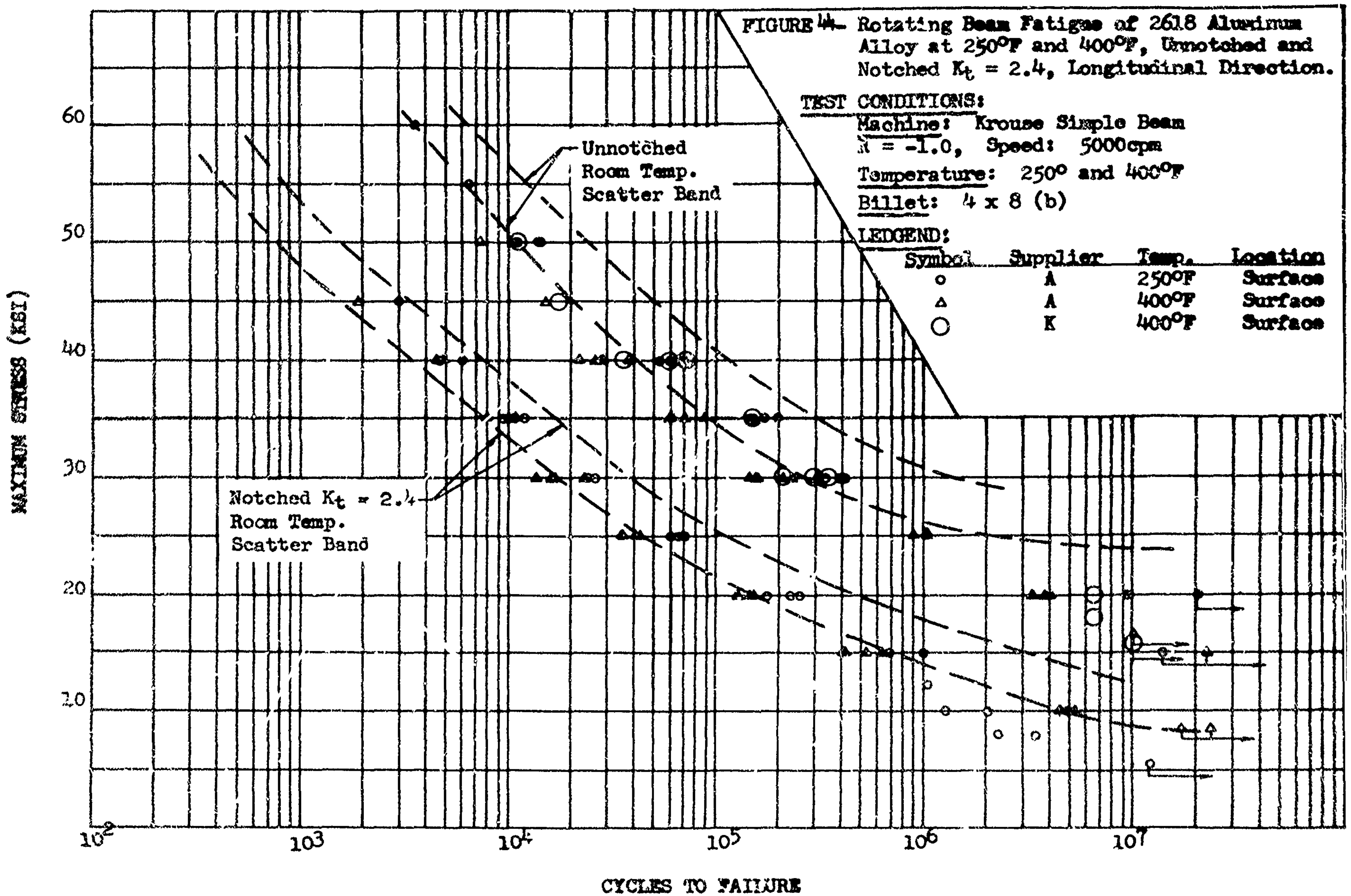
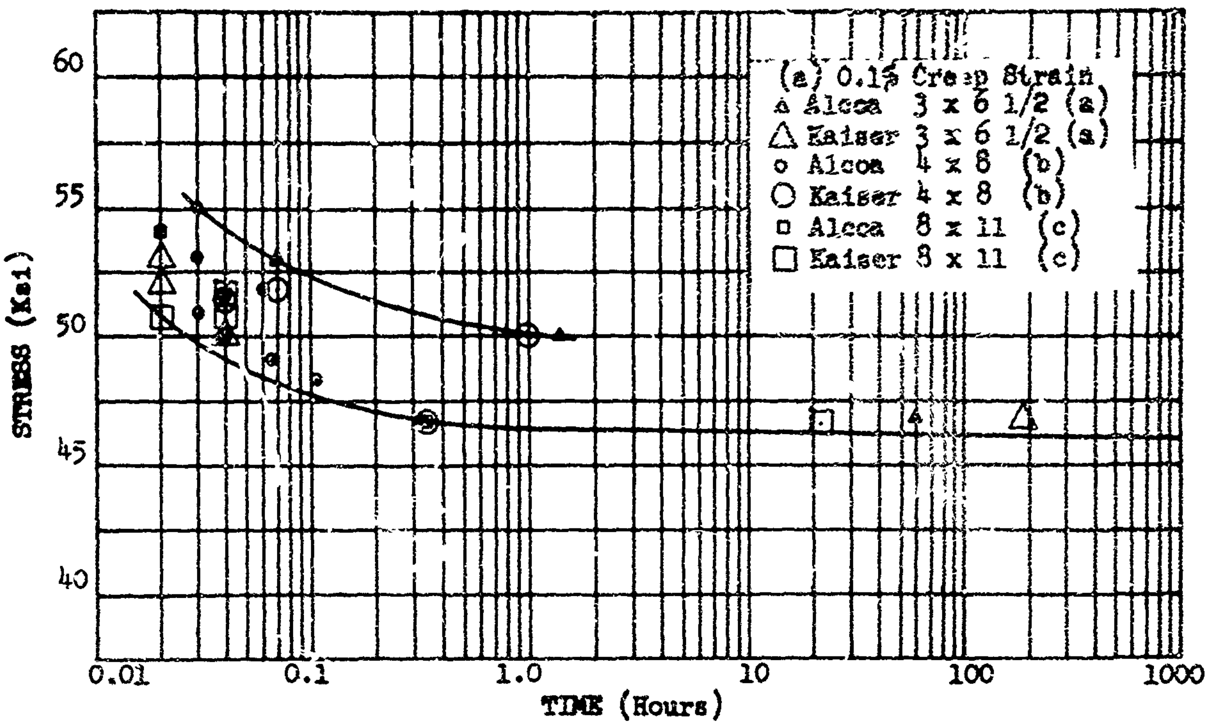


FIGURE 44 Rotating Beam Fatigue of 2618 Aluminum Alloy at 250°F and 400°F, Unnotched and Notched $K_t = 2.4$, Longitudinal Direction.



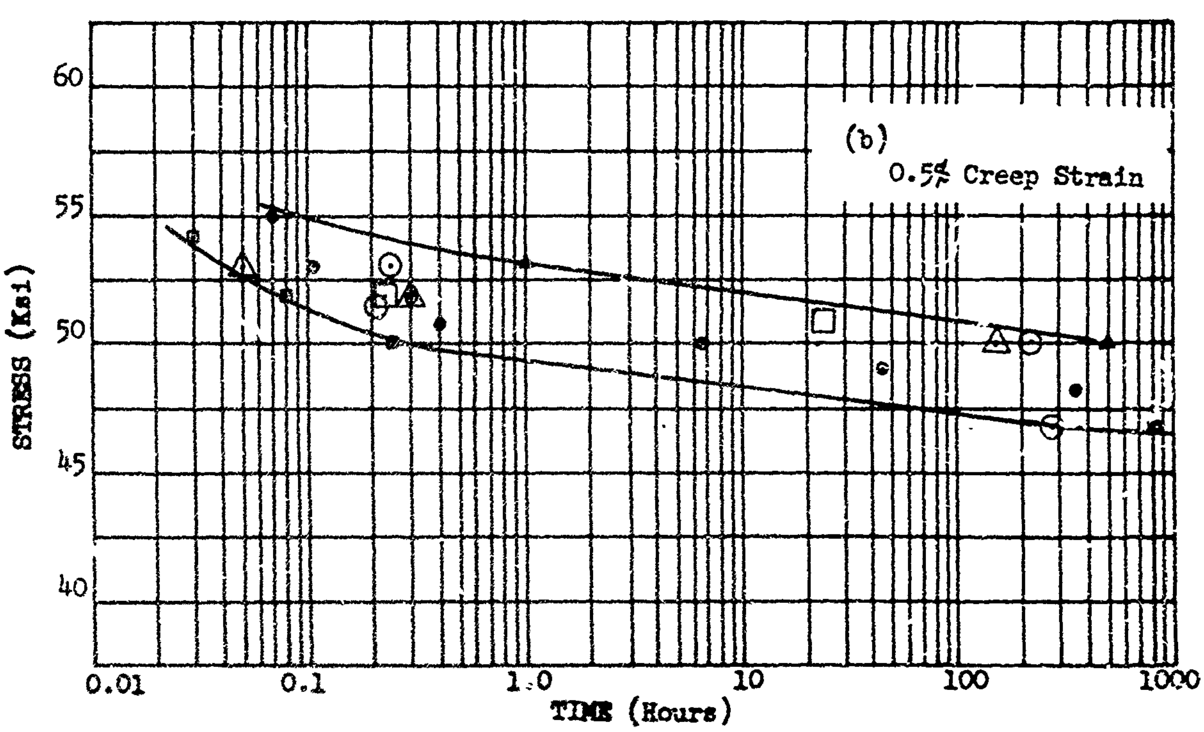
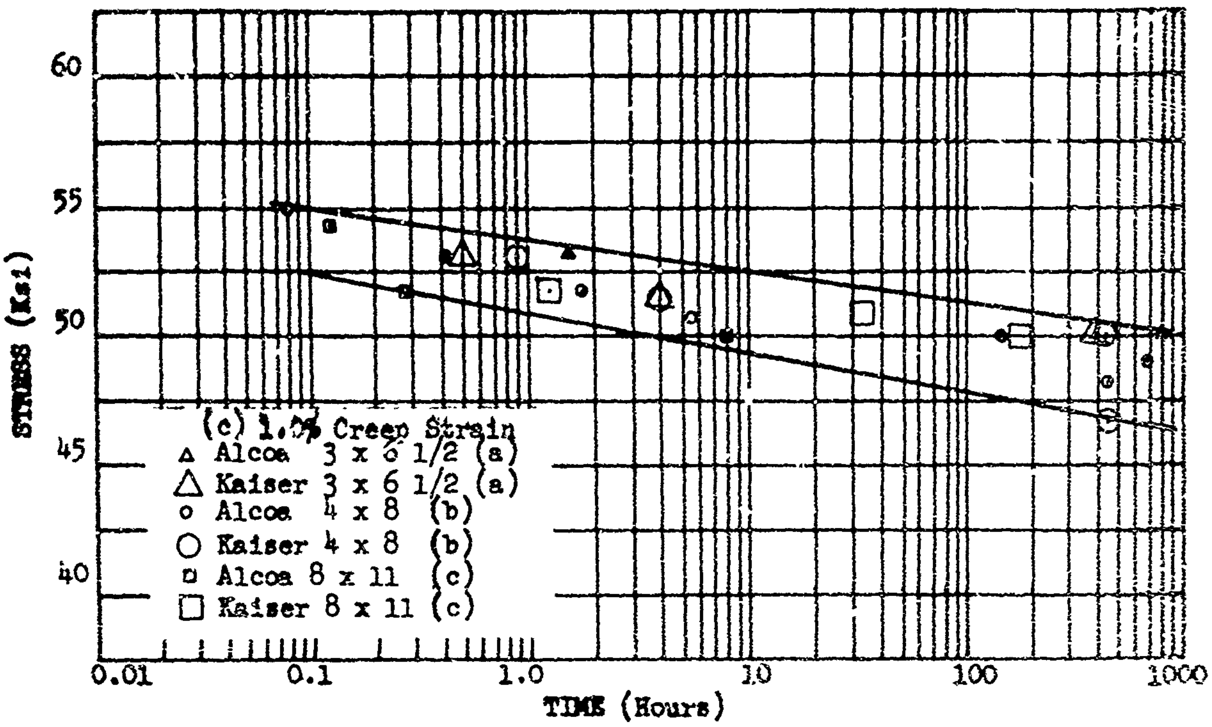


Figure 45

Creep Strain and Creep Rupture Properties of 2618-T61 Aluminum Forgings at 250°F



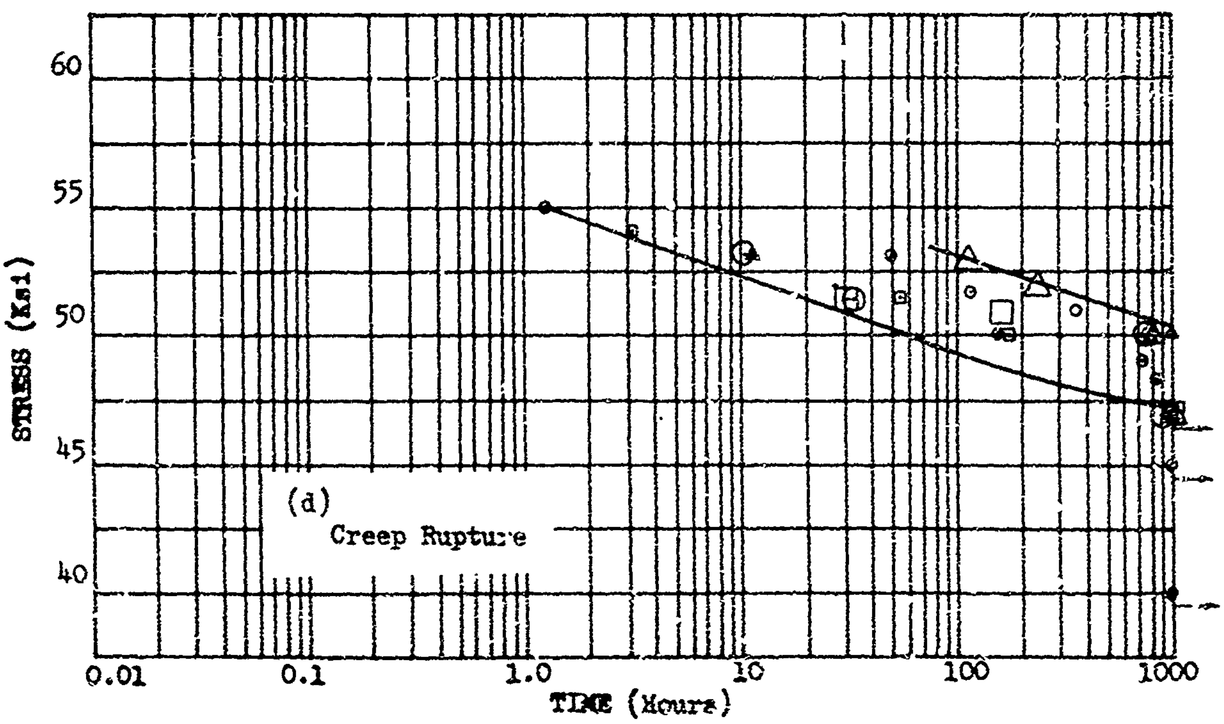
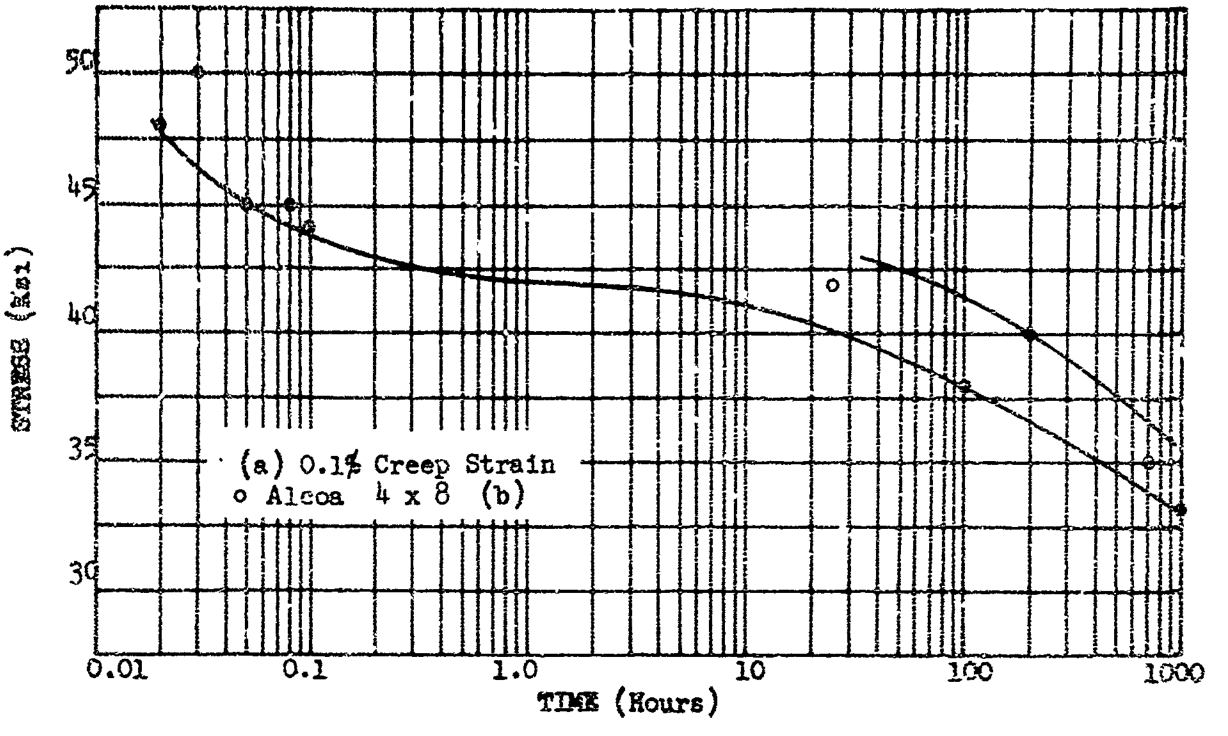


Figure 45 Concluded



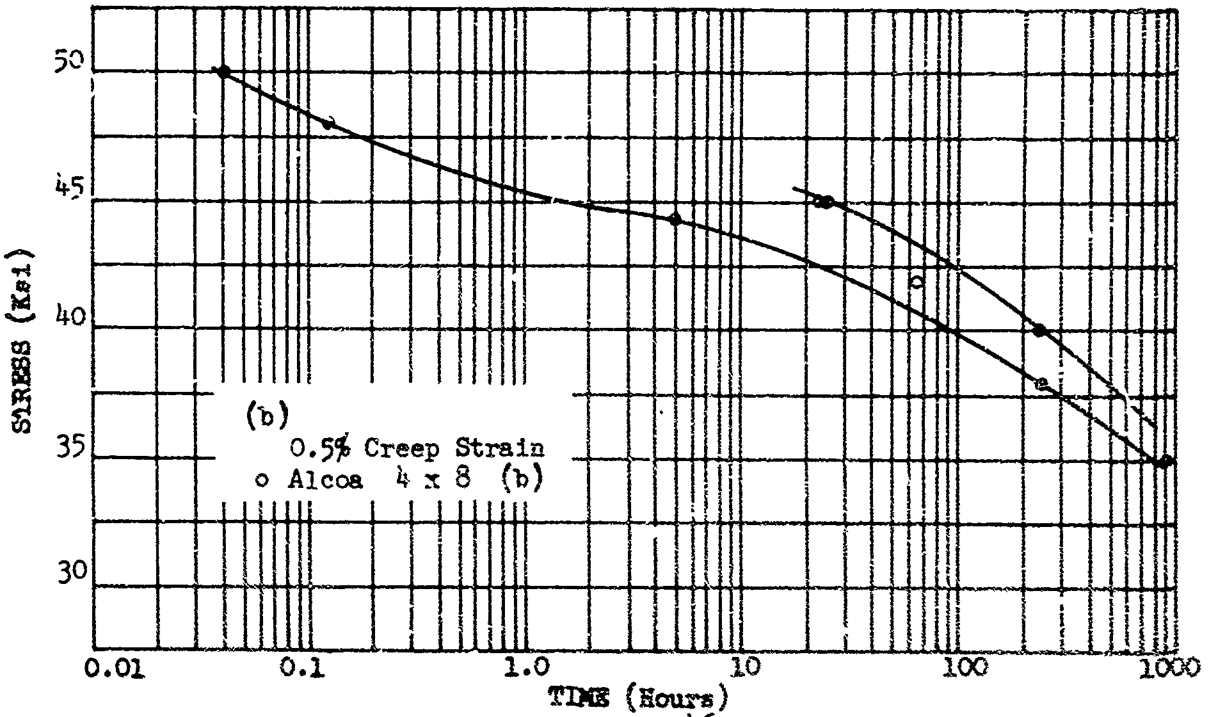
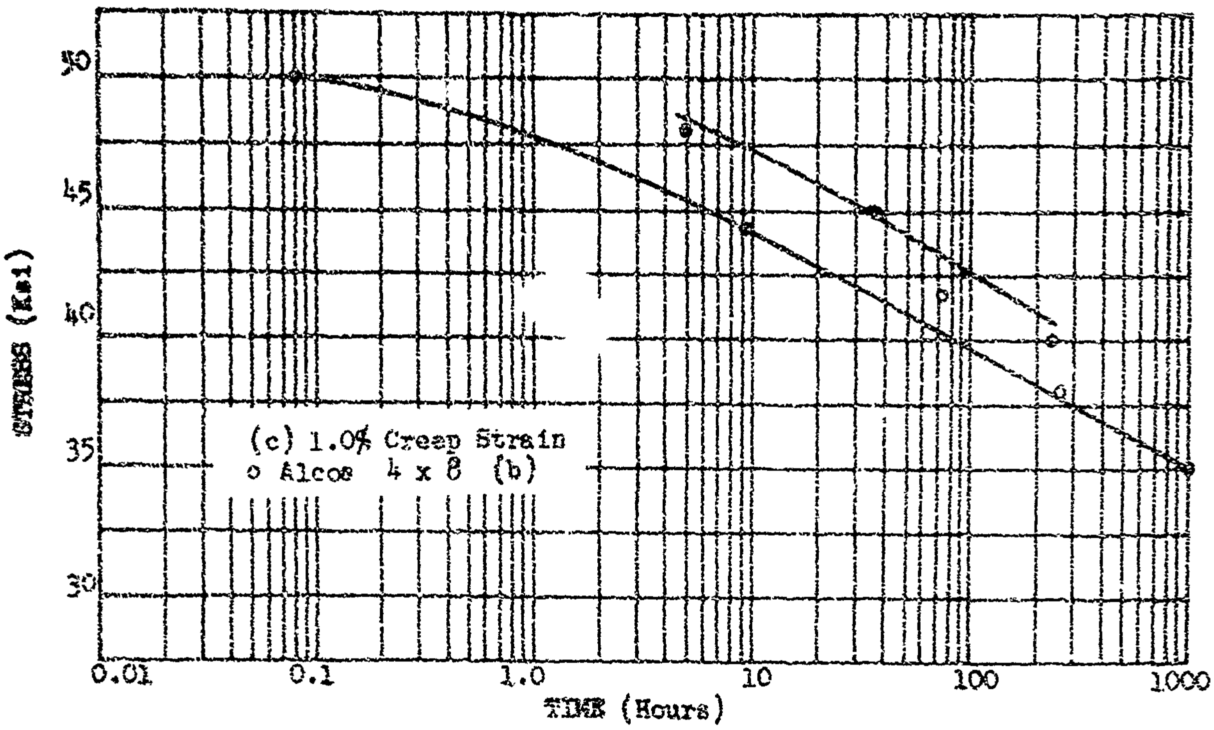


Figure 46

Creep Strain and Creep Rupture Properties of 2618-T61 Aluminum Forgings at 325°F



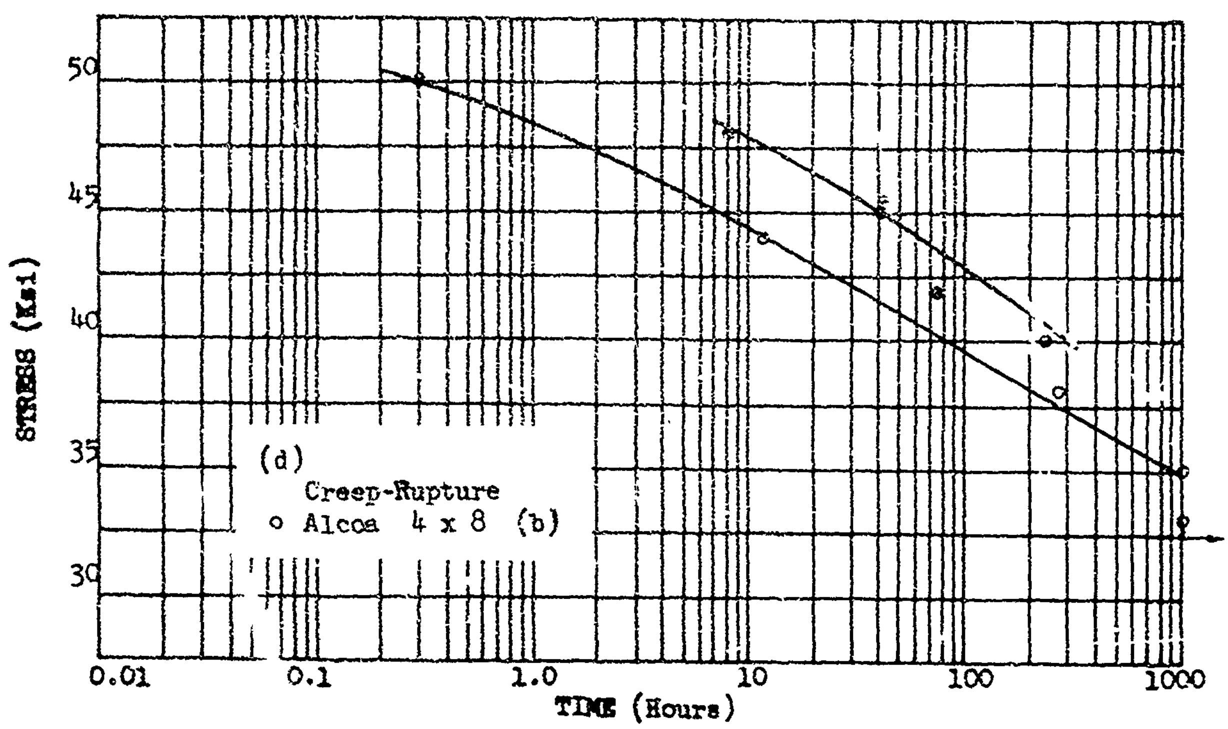
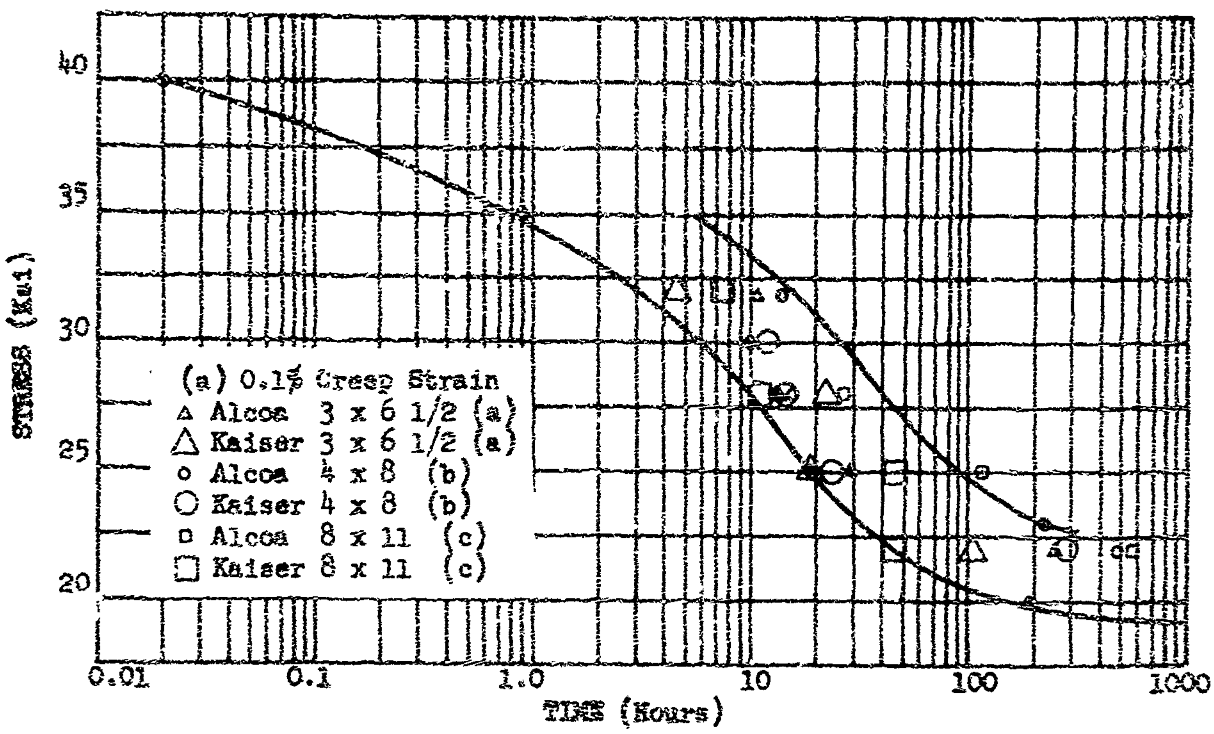


Figure 46 Concluded



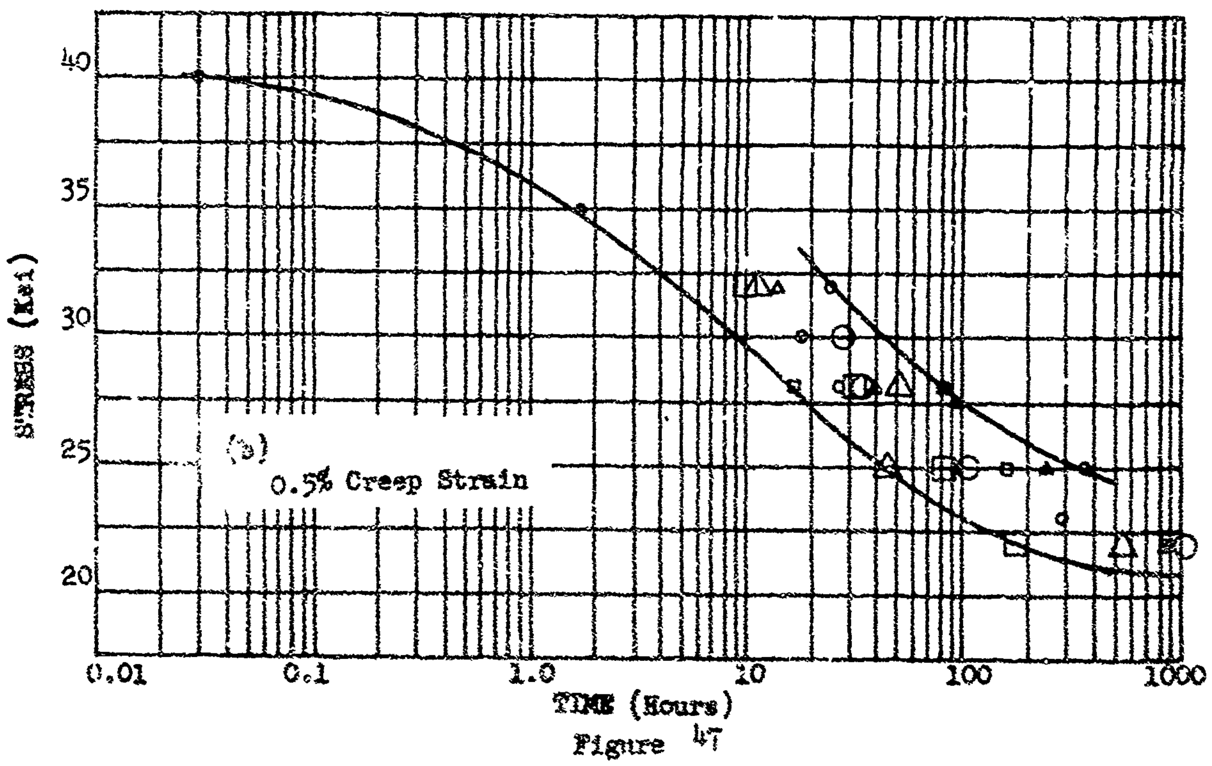
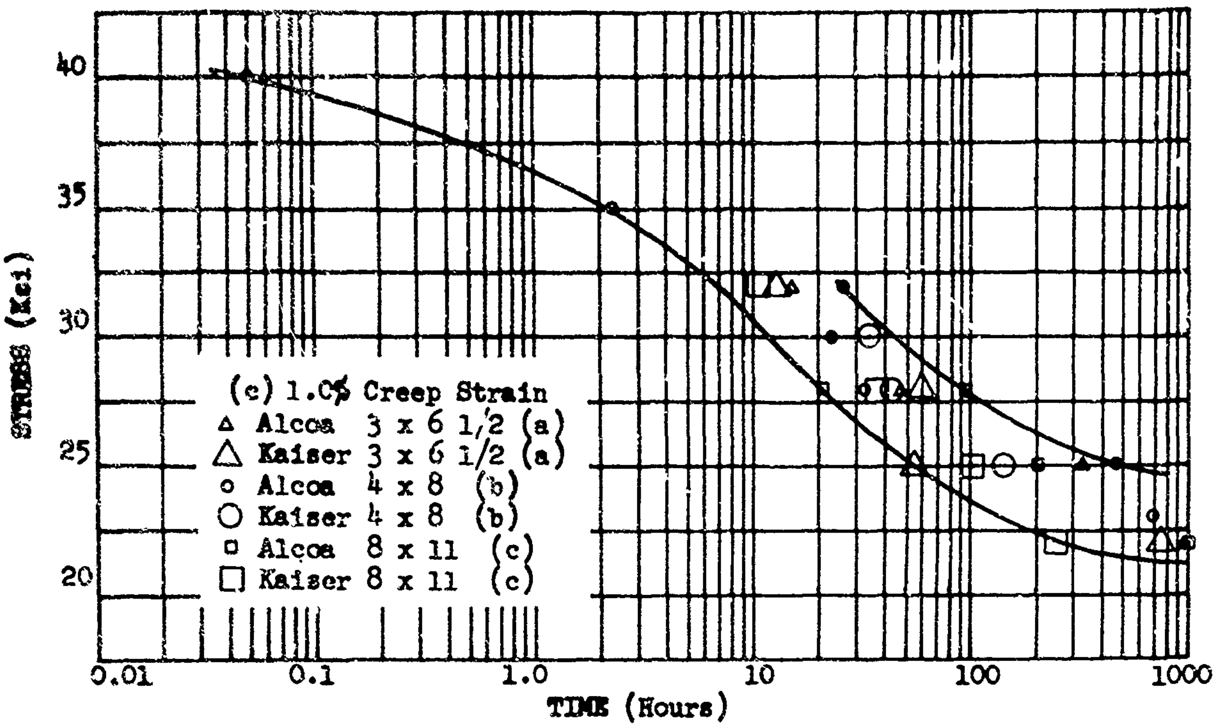


Figure 47

Creep Strain and Creep Rupture Properties of 2618-T61 Aluminum Forgings at 400°F



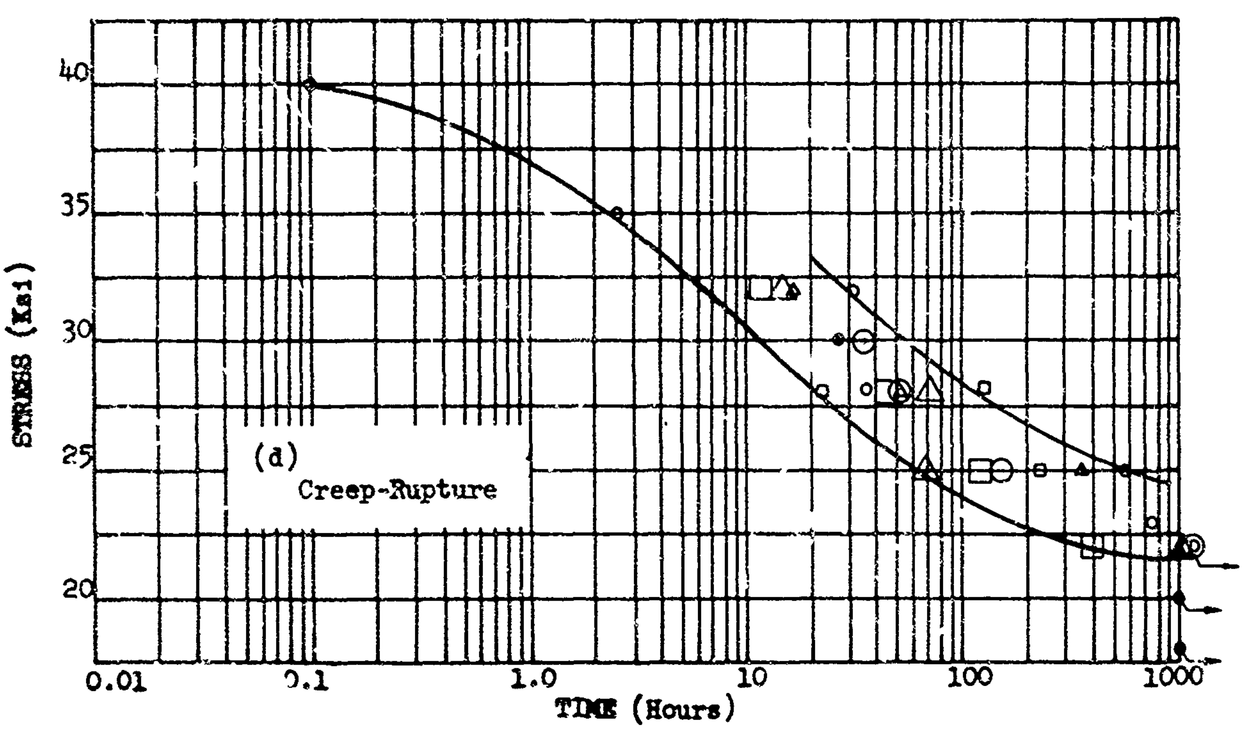
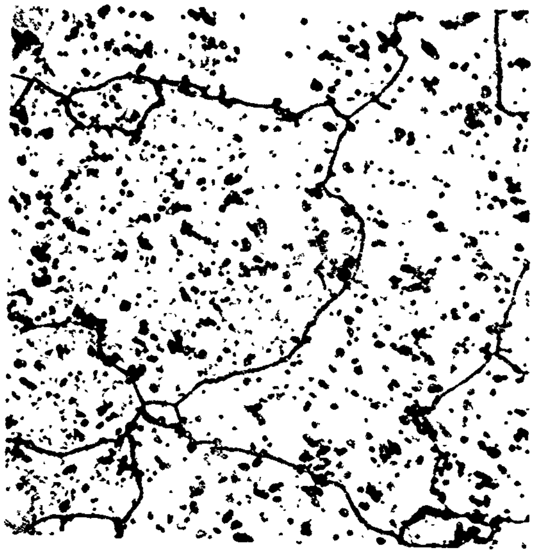
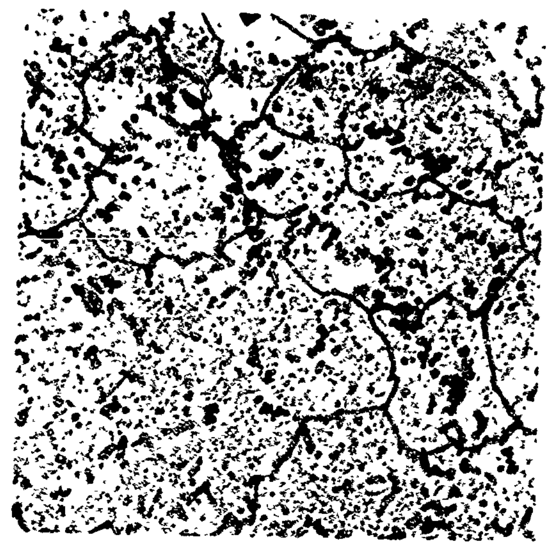


Figure 47 Concluded



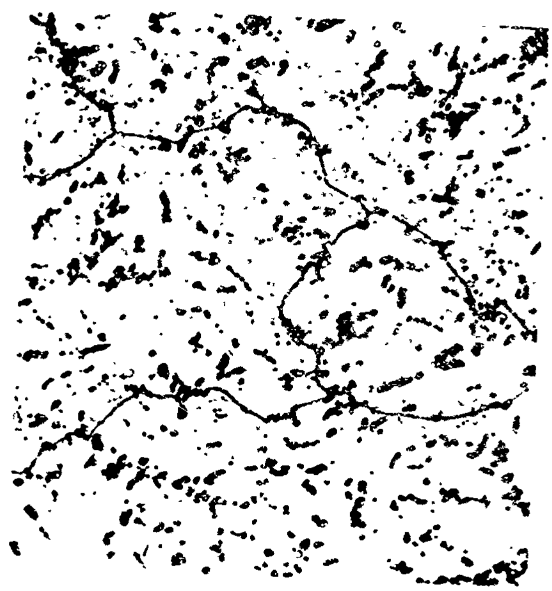
Alcoa



Kaiser

(a) No Exposure
250X, Keller's Etch

Alcoa

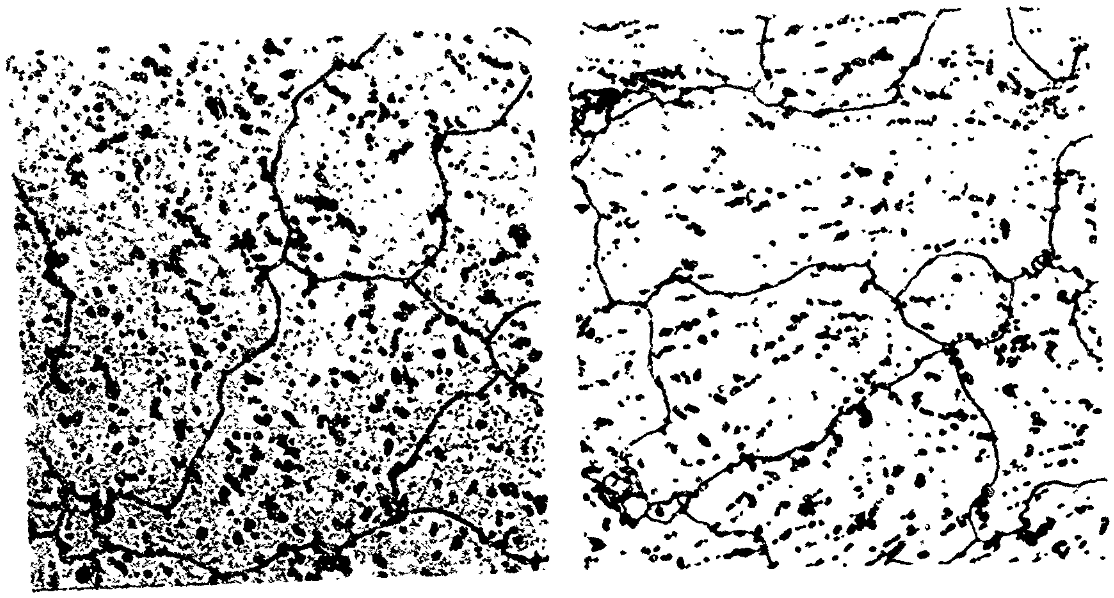


Kaiser

(b) 10 Hour Exposure
250X, Keller's Etch

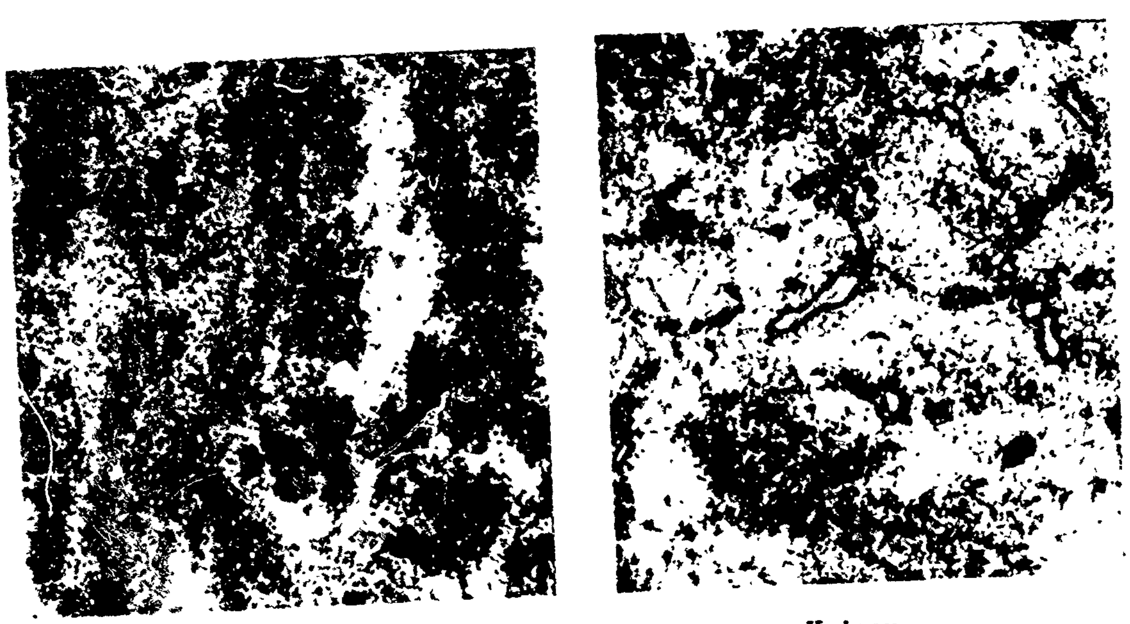
Figure 48

Microstructure of 2618-T61, 4" x 8" Billet (b), Surface Material
Unexposed and Exposed at 325°F for 10, 1000 and 1000 Hours
Long Transverse, Orientation



Alcoa Kaiser

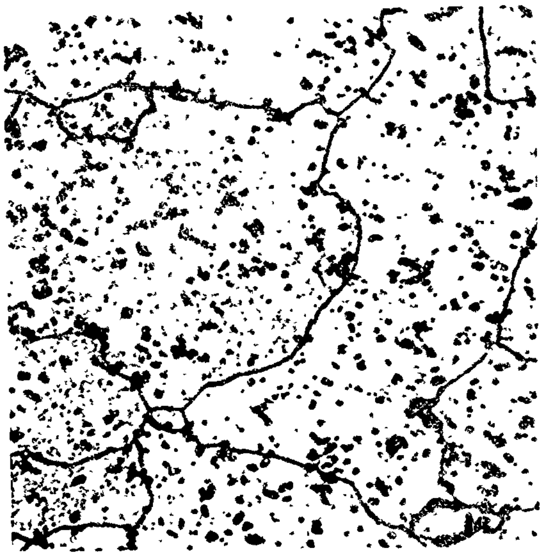
(c) 100 Hour Exposure
250X, Keller's Etch



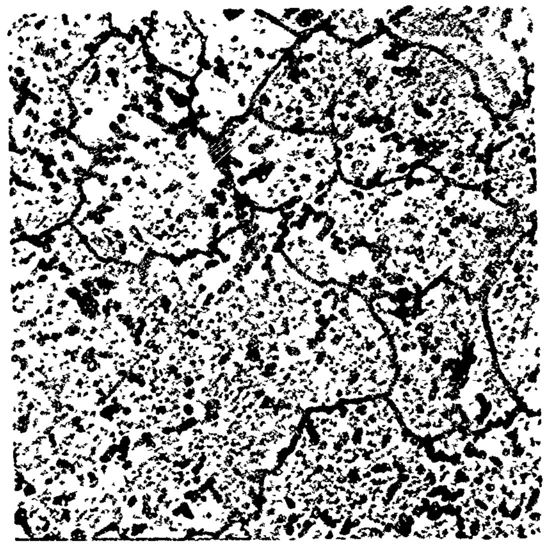
Alcoa Kaiser

(d) 1000 Hour Exposure
1000X, Keller's Etch

Figure 48 Concluded



Alcoa



Kaiser

(a) No Exposure
250X, Keller's Etch

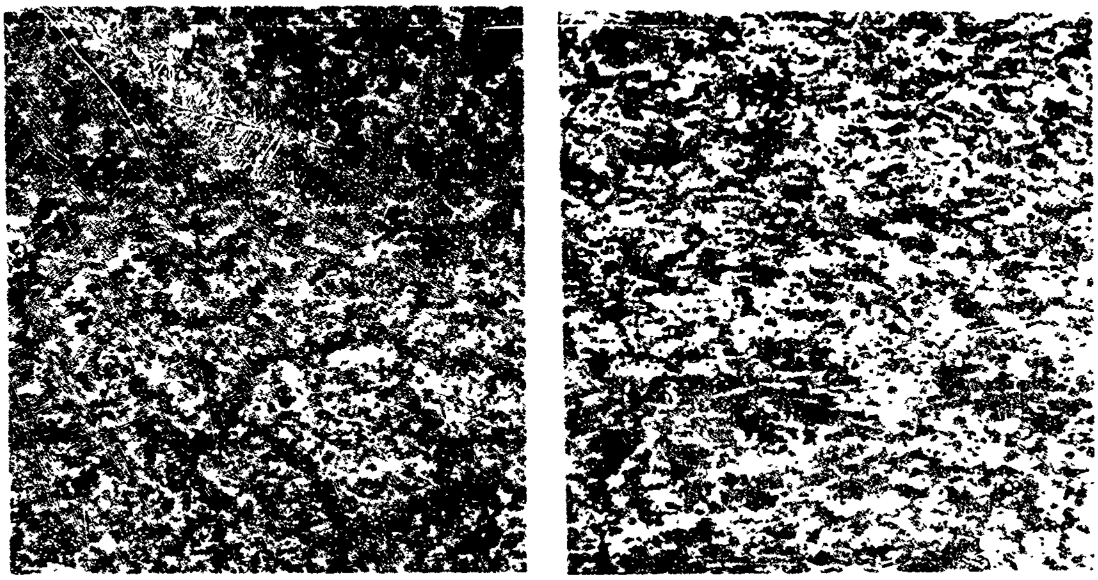
Alcoa

Kaiser

(b) 10 Hour Exposure
250X, Keller's Etch

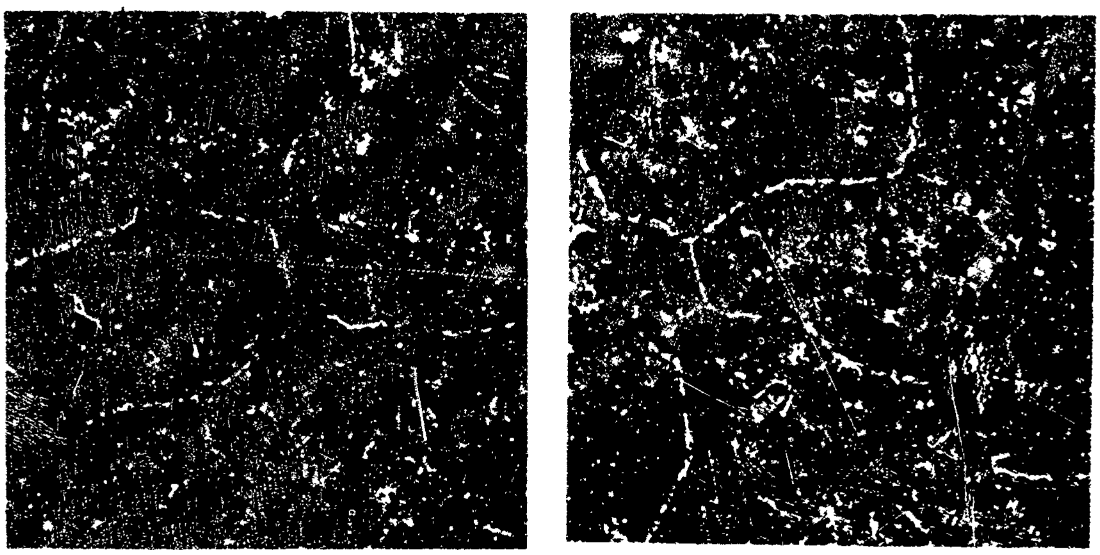
Figure 49

Microstructure of 2618-T61, 4" x 8" Billet (b), Surface Material
Unexposed and Exposed at 400°F for 10,100 and 1000 Hours
Long Transverse Orientation



Alcoa Kaiser

(c) 100 Hour Exposure
250X, Keller's Etch



Alcoa Kaiser

(d) 1000 Hour Exposure
1000X, Keller's Etch

Figure 49 Concluded

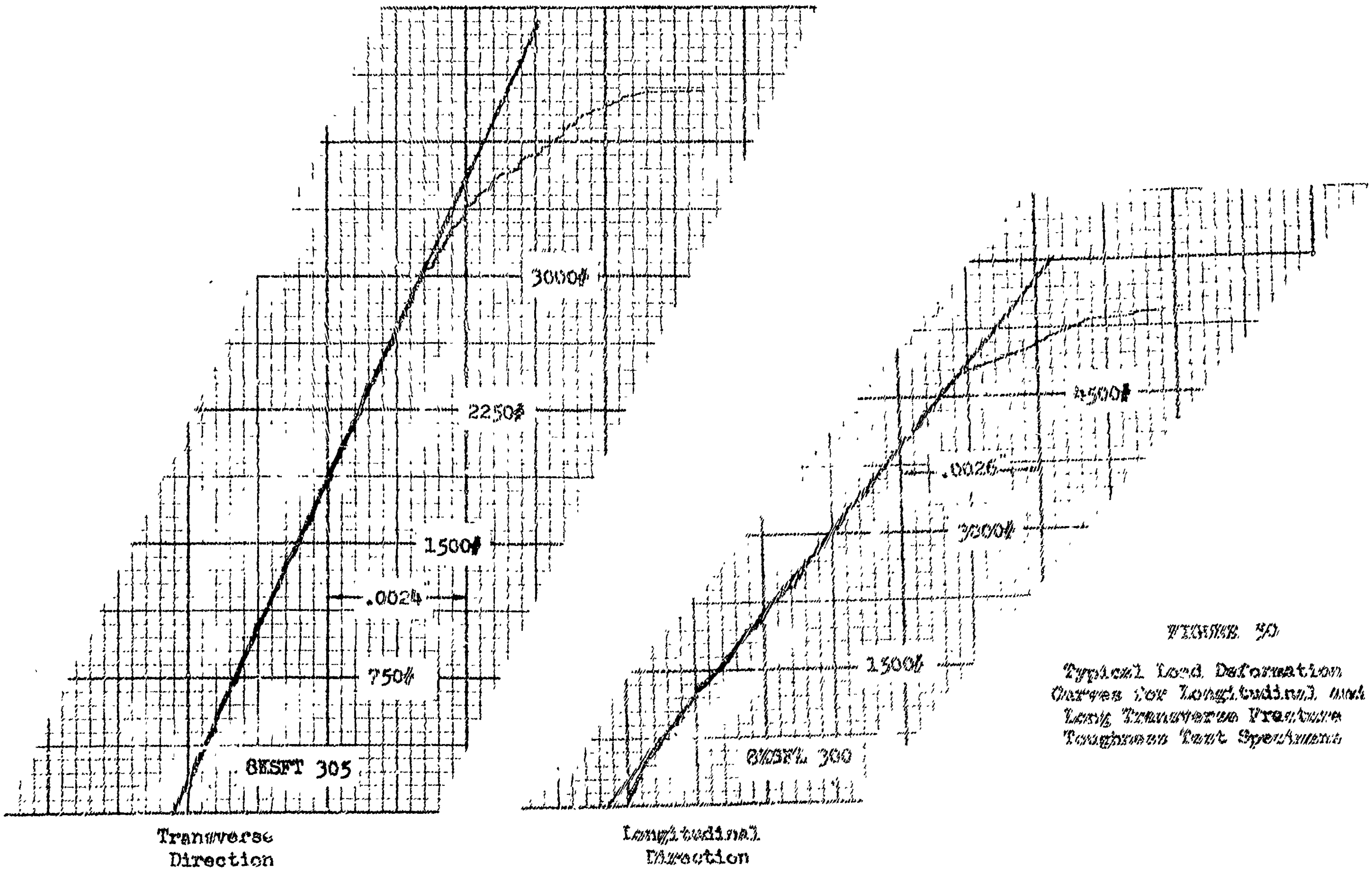
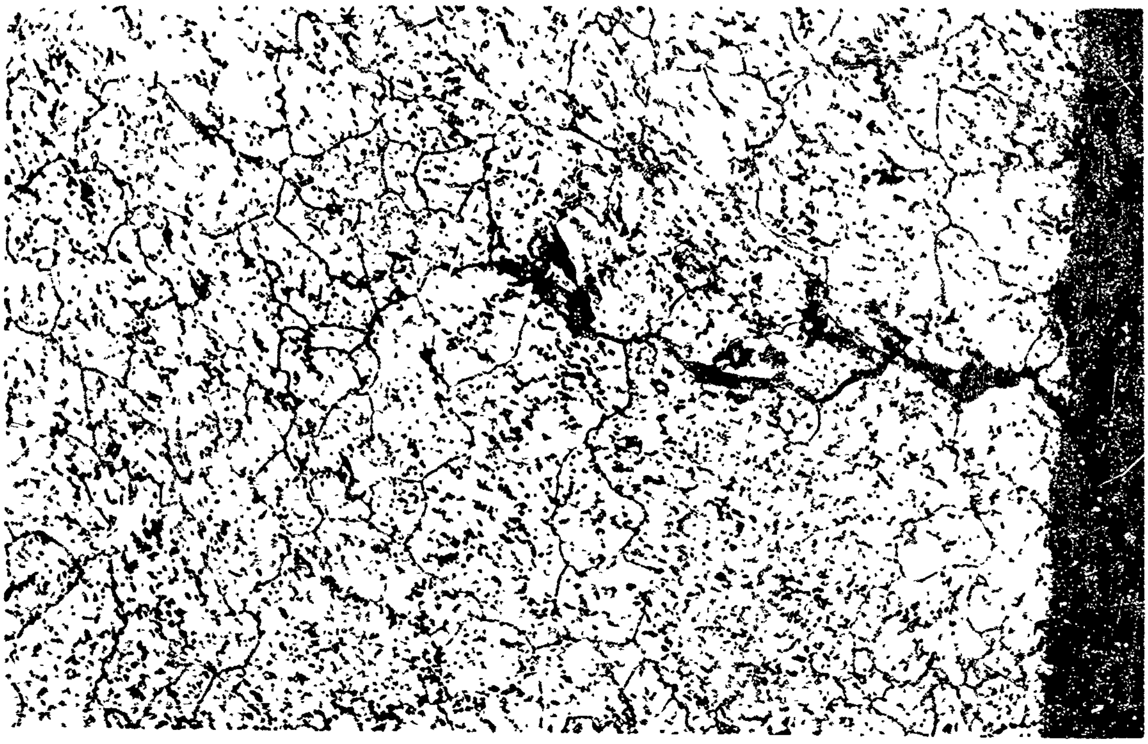
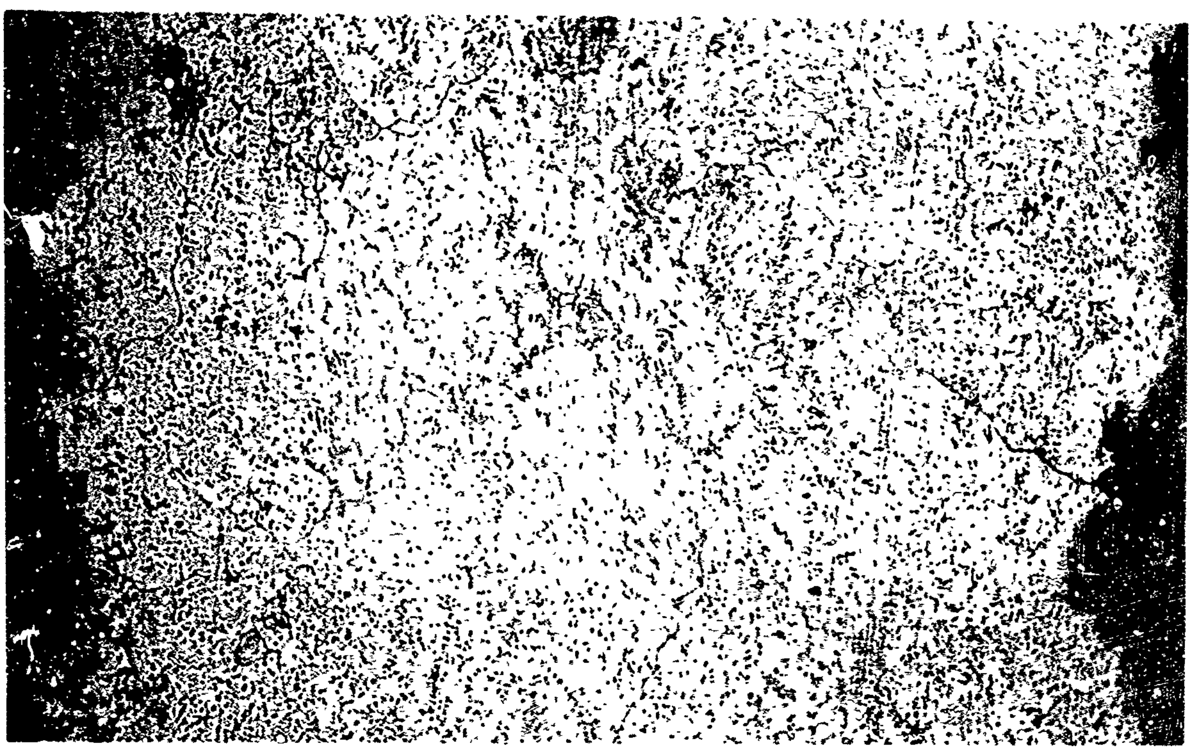


FIGURE 30

Typical Load Deformation Curves for Longitudinal and Long Transverse Fracture Toughness Test Specimens



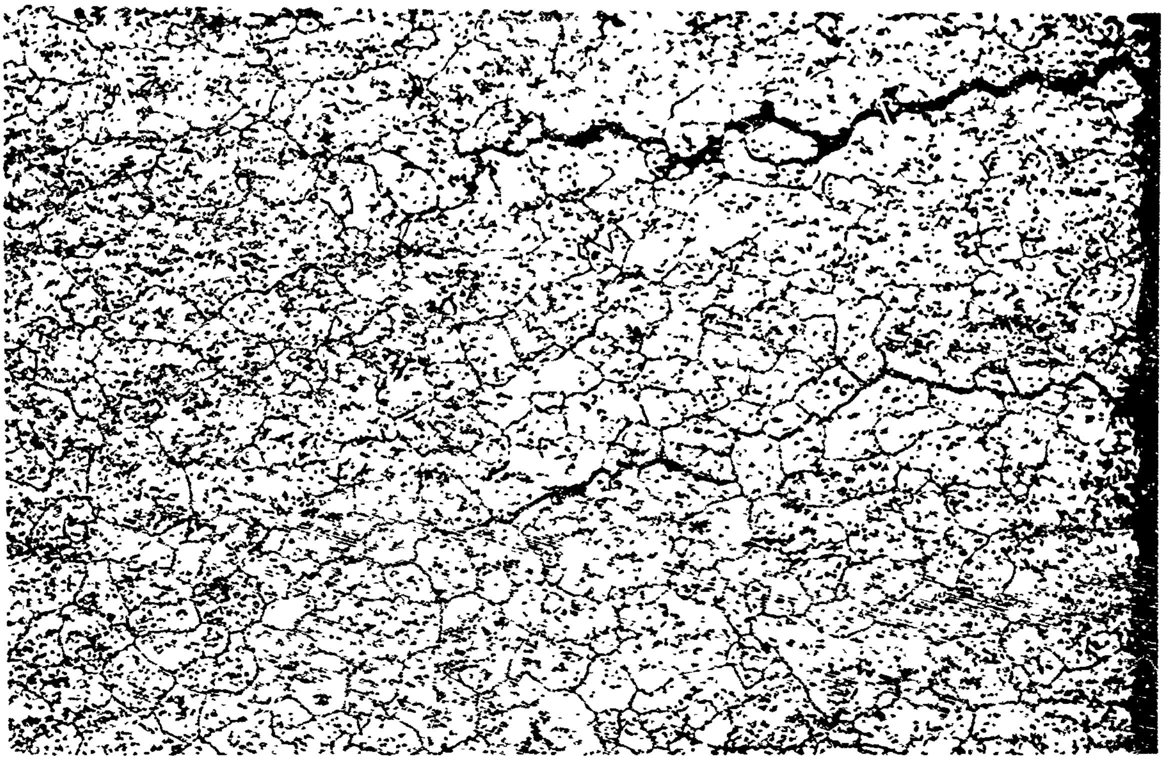
(a) Kaiser, 3" x 6 1/2", Billet (a), Failed in 120 Hours
100X, Keller's Etch



(b) Alcoa, 3" x 6 1/2", Billet (a), No Apparent Failure, 2016 Hours
100X, Keller's Etch

Figure 51

Typical Surfaces of Stress Corrosion Bend
Test Specimens After Exposure, Long Transverse Direction



(a) Kaiser, 4" x 8" Billet (d), Failed in 100 Hours
100X, Keller's Etch

(b) Alcoa, 3" x 6 1/2" Billet (a), Failed in 470 Hours
100X, Keller's Etch

Figure 52

Typical Surfaces of Stress Corrosion Bend
Test Specimens After Exposure, Short Transverse Direction

Alcoa; 3' x 6 1/2", Billet (A), No Failure, 2016 Hours
100X, Keller's Etch

Figure 53

Typical Surface of Stress Corrosion Bend
Test Specimens After Exposure, Longitudinal Direction

Appendix A

Tabulated Data Developed
During the Program and
Prior to Initiation of
the Program

Table XIV

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE AND MID-THICKNESS OF 3" X 6-1/2" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTION

Billet (a)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
6ASTL1		Surface	65.2	54.9	7.1	10.2
6ASTL2	A	L	64.9	54.0	7.1	9.9
6ASTL3			65.2	54.4	7.1	9.9
Average			65.1	54.4	7.1	10.0
6KSTL1		Surface	63.7	50.4	9.3	9.8
6KSTL2	K	L	63.7	50.4	10.0	9.8
6KSTL3			63.7	51.3	9.3	10.6
Average			63.7	50.7	9.5	10.1
6AMTL1		Mid-Thick	64.8	54.8	9.3	9.9
6AMTL2	A		65.3	55.0	7.1	9.8
6AMTL3		L	64.0	54.1	7.9	9.6
Average			64.7	54.6	8.1	9.8
6KMTL1		Mid-Thick	63.6	49.9	10.0	11.1
6KMTL2	K		64.3	50.6	10.0	10.0
6KMTL3		L	64.4	52.9	10.0	11.2
Average			64.1	51.1	10.0	10.8
6ASTT13		Surface	63.6	54.3	4.3	9.7
6ASTT14	A	LT	63.9	54.4	4.3	10.0
6ASTT15			63.8	54.2	4.3	9.7
Average			63.8	54.3	4.3	9.8
6KSTT13		Surface	61.7	49.2	5.7	9.5
6KSTT14	K	LT	61.5	49.9	4.3	10.8
6KSTT15			61.6	48.9	5.0	10.7
Average			61.6	49.3	5.0	10.3
6AMTT13		Mid-Thick	62.1	53.3	7.1	9.7
6AMTT14	A		62.5	52.0	7.9	9.9
6AMTT15		LT	60.7	52.2	6.4	9.9
Average			61.8	52.5	7.1	9.8
6KMTT13		Mid-Thick	61.3	48.9	7.1	10.7
6KMTT14	K		61.1	48.9	7.1	11.2
6KMTT15		LT	60.0	48.2	5.7	10.5
Average			60.8	48.7	6.6	10.8

Table XV

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 4" x 8" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTION
Billet (b)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)	Modulus x10[6] (PSI)
8ASTL1		Surface	61.2	48.7	10.0	10.0
8ASTL2	A	L	60.8	48.7	10.0	10.6
8ASTL3			60.6	48.7	12.1	11.1
Average			60.9	48.7	10.7	10.6
8KSTL25		Surface	62.8	50.4	12.9	10.6
8KSTL26	K	L	63.0	51.4	10.7	10.6
8KSTL27			62.0	47.9	11.4	10.6
Average			62.6	49.9	11.7	10.6
8AQTL1		Quarter-	60.1	48.7	12.1	10.0
8AQTL2	A	Thick	59.4	48.8	11.4	8.9
8AQTL3		L	59.3	48.3	11.4	8.9
Average			59.6	48.6	11.6	9.3
8KQTL25		Quarter-	62.2	49.3	11.4	8.9
8KQTL26	K	Thick	61.5	48.6	9.3	10.0
8KQTL27		L	62.4	49.4	10.7	9.8
Average			62.0	49.1	10.5	9.6
8AMTL1		Mid-	62.7	50.9	10.0	10.2
8AMTL2	A	Thick	62.4	49.9	10.0	10.8
8AMTL3		L	61.3	50.9	10.0	10.6
Average			62.1	50.6	10.0	10.5
8KMTL37		Mid-	63.5	52.0	10.0	11.1
8KMTL38	K	Thick	63.2	52.0	10.0	10.9
8KMTL39		L	63.6	52.0	10.0	10.5
Average			63.4	52.0	10.0	10.8
8ASTT13		Surface	59.6	47.3	7.9	10.6
8ASTT14	A	LT	59.6	48.4	7.2	10.0
8ASTT15			59.7	48.1	7.2	10.0
Average			59.6	47.9	7.4	10.2
8KSTT37		Surface	61.8	49.2	8.6	10.6
8KSTT38	K	LT	62.0	50.1	8.6	10.6
8KSTT39			61.4	49.7	8.6	10.2
Average			61.7	49.7	8.6	10.5

Table XV- Continued

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)	Modulus x10^6 (PSI)
8AQTT13		Quarter	58.1	46.1	6.4	10.3
8AQTT14	A	Thick	58.2	47.2	6.4	9.4
8AQTT15		LT	58.2	47.5	6.4	10.7
Average			58.2	46.9	6.4	10.1
8KQTT36		Quarter	60.2	48.0	7.9	9.7
8KQTT37	K	Thick	60.4	48.5	8.6	9.4
8KQTT38		LT	60.6	48.1	7.9	10.2
Average			60.4	48.2	8.1	9.8
8AMTT13		Mid-	58.6	47.7	7.1	9.8
8AMTT14	A	Thick	59.0	47.5	7.1	10.4
8AMTT15		LT	59.3	47.5	7.9	10.0
Average			58.9	47.5	7.4	10.1
8KMTT49		Mid-	59.4	49.4	7.9	9.6
8KMTT50	K	Thick	59.8	49.6	8.6	9.6
8KMTT51		LT	59.7	49.6	7.9	9.8
Average			59.6	49.5	8.1	9.7
8AMTS25		Mid-	58.4	48.8	6.4	10.4
8AMTS26	A	Thick	59.4	48.9	6.4	10.4
8AMTS27		ST	59.4	48.4	7.1	10.4
Average			59.0	48.7	6.6	10.4
8KMTS61		Mid-	60.2	49.4	7.9	9.8
8KMTS62	K	Thick	59.9	49.0	7.1	10.0
8KMTS63		ST	60.0	48.9	7.1	10.5
Average			60.0	49.1	7.4	10.1

Table XVI

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT
ROOM TEMPERATURE FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS
OF 8" x 11" BILLET, LONGITUDINAL, LONG TRANSVERSE AND
SHORT TRANSVERSE DIRECTIONS
Billet (c)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)	Modulus x10^6 (PSI)
11ASTL49		Surface	61.4	49.7	10.5	10.8
11ASTL50	A	L	62.4	49.7	10.5	10.7
11ASTL51			61.9	48.0	12.0	10.8
Average			61.9	49.1	11.0	10.8
11KSTL69		Surface	63.2	52.0	7.0	10.4
11KSTL70	K	L	64.0	52.0	11.0	10.6
11KSTL71			63.6	50.2	10.0	10.6
Average			63.6	51.4	9.3	10.5
11AQTL1		Quarter-Thick	62.2	48.9	12.5	10.9
11AQTL2	A	Thick	62.2	48.0	12.5	11.1
11AQTL3		L	61.0	47.8	10.0	10.9
Average			61.8	48.2	11.6	11.0
11KQTL28		Quarter-	62.2	50.0	12.0	10.6
11KQTL29	K	Thick	62.3	49.9	12.0	10.9
11KQTL30		L	63.0	50.4	12.0	10.8
Average			62.5	50.1	12.0	10.8
11AMTL1		Mid-	60.8	46.2	13.0	10.5
11AMTL2	A	Thick	60.6	45.9	12.0	10.9
11AMTL3		L	60.8	46.0	13.0	10.7
Average			60.7	46.0	12.6	10.7
11KMTL28		Mid-	62.9	50.0	12.0	10.7
11KMTL29	K	Thick	62.9	50.2	12.0	10.6
11KMTL30		L	62.9	50.3	13.0	10.6
Average			62.9	50.2	12.3	10.6
11AQTT10		Quarter-	56.1	43.1	7.5	10.3
11AQTT11	A	Thick	57.1	46.2	5.0	10.9
11AQTT12		LT	56.8	45.8	4.0	10.8
11AQTT13			57.8	46.0	7.0	11.1
11AQTT14			58.1	46.0	7.0	10.8
Average			57.2	45.4	6.1	10.8

Table XVI - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)	Modulus x10^6 (PSI)
11KQTT37			60.0	48.2	6.5	10.4
11KQTT38		Quarter-	61.8	50.3	7.0	10.2
11KQTT39	K	Thick	61.7	50.1	7.5	10.6
11KQTT40		LT	61.0	49.7	7.0	10.0
11KQTT41			61.0	48.7	5.0	10.0
Average			61.1	49.4	6.6	10.2
11AMTT10			59.1	47.9	7.5	10.3
11AMTT11		Mid-	58.7	47.2	6.0	10.5
11AMTT12	A	Thick	58.6	47.2	6.0	10.1
11AMTT13		LT	59.0	47.9	6.5	10.0
11AMTT14			59.0	47.2	6.5	10.7
Average			58.9	47.5	6.5	10.3
11KMTT37			60.0	49.2	6.5	10.4
11KMTT38		Mid-	60.2	48.6	7.0	10.9
11KMTT39	K	Thick	60.0	48.6	7.0	10.4
11KMTT40		LT	59.6	48.6	7.0	10.4
11KMTT41			60.7	49.0	8.0	10.4
Average			60.1	48.8	7.1	10.5
11ASTS59			59.3	45.9	7.5	10.5
11ASTS60		Surface	58.0	45.4	7.5	10.3
11ASTS61	A	ST	57.0	44.6	7.0	10.0
11ASTS62			58.0	45.9	7.0	10.3
11ASTS63			58.0	46.4	7.0	9.6
Average			58.1	45.6	7.2	10.2
11KSTS79			59.9	48.2	7.2	10.6
11KSTS80		Surface	62.0	50.3	5.8	10.4
11KSTS81	K	ST	60.9	50.1	5.8	10.3
11KSTS82			61.0	49.7	7.5	10.6
11KSTS83			58.3	48.7	4.7	10.4
Average			60.4	49.4	6.2	10.5
11AQTS19			57.4	46.0	4.7	9.9
11AQTS20		Quarter-	58.2	45.9	6.0	10.2
11AQTS21	A	Thick	58.7	46.0	7.4	10.2
11AQTS22		ST	57.9	46.2	7.1	9.9
11AQTS23			59.2	47.8	7.1	9.6
Average			58.3	46.4	6.5	10.0
11KQTS46			65.3	54.4	6.1	10.4
11KQTS47		Quarter-	63.0	51.5	7.1	10.1
11KQTS48	K	Thick	62.8	51.2	7.2	10.3
11KQTS49		ST	62.0	51.2	7.2	10.3
11KQTS50			62.8	51.8	7.1	10.1
Average			63.2	52.0	7.1	10.2

Table XVII

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT
ROOM TEMPERATURE 250°F, 325°F AND 400°F,
FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS
OF 4" X 8" KAISER BILLET, LONGITUDINAL,
LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTION

Billet (d)

Specimen	Billet Location	Test Temp.(°F)	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
8KSTL363	Surface		61.9	47.8	13.5	10.9
8KSTL364	L	RT	62.3	48.2	12.1	11.5
8KSTL365			62.3	48.2	12.1	10.9
Average			62.2	48.1	12.6	11.0
8KSTT366	Surface		59.9	46.3	7.9	10.5
8KSTT367	LT	RT	60.0	46.6	8.6	9.7
8KSTT368			59.5	47.0	5.7	10.1
Average			59.8	46.6	7.4	10.1
8KQTL378	Quarter		62.4	48.0	12.9	12.2
8KQTL379	Thick	RT	61.0	46.9	12.9	11.2
8KQTL380	L		61.8	46.9	10.7	11.2
Average			61.7	47.3	12.2	11.5
8KQTL381	Quarter		60.0	45.8	8.6	10.7
8KQTT382	Thick	RT	59.8	46.2	8.6	10.6
8KQTT383	LT		60.0	45.4	9.3	10.0
Average			59.9	45.8	8.8	10.4
8KMTL336	Mid-		63.8	50.0	10.7	11.5
8KMTL337	Thick	RT	63.9	49.4	11.0	10.2
8KMTL338	L		64.0	49.9	11.0	10.7
Average			63.9	49.8	10.9	10.8
8KMTT339	Mid-		61.9	47.8	9.3	10.6
8KMTT340	Thick	RT	61.6	47.8	9.0	10.6
8KMTT341	LT		61.1	47.3	9.0	10.3
Average			61.5	47.6	9.1	10.5
8KMTS351	Mid-		60.0	48.9	5.7	9.4
8KMTS352	Thick	RT	60.0	48.2	5.7	9.6
8KMTS353	ST		59.6	48.5	5.0	9.6
Average			59.9	48.6	5.5	9.5
8KSTT369	Surface		57.7	46.1	7.8	10.2
8KSTT370	LT	250	57.1	45.9	(2)	10.6
8KSTT371			58.2	44.8	10.7	9.4
Average			57.7	45.6	9.3	10.1
8KQTT384	Quarter		57.9	(1)	7.8	(1)
8KQTT385	Thick	250	58.1	46.0	10.0	9.6
8KQTT386	LT		57.0	45.9	10.0	9.4
Average			57.7	47.0	9.5	9.5

Table XVII - Continued

Specimen	Billet Location	Test Temp.(°F)	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
8KMTT342	Mid-		54.7	49.0	12.1	9.6
8KMTT343	Thick	250	56.4	47.2	(2)	9.7
8KMTT344	LT		57.0	45.7	11.4	9.1
Average			56.9	47.3	11.8	9.5
8KMTS354	Mid-		55.4	45.9	(2)	8.2
8KMTS355	Thick	250	55.8	45.5	5.0	8.4
8KMTS356	ST		55.0	46.6	5.0	10.2
Average			55.4	46.0	5.0	8.9
8KSTT372	Surface		53.6	43.9	15.7	9.3
8KSTT373	LT	325	53.8	44.2	15.0	9.6
8KSTT374			54.0	44.4	13.6	10.0
Average			53.8	44.2	14.8	9.6
8KQTT387	Quarter		53.0	43.7	17.1	9.0
8KQTT388	Thick	325	53.2	43.4	16.4	9.5
8KQTT389	LT		53.2	43.6	15.7	9.0
Average			53.1	43.6	16.4	9.2
8KMTT345	Mid-		52.8	44.3	15.7	10.0
8KMTT346	Thick	325	53.4	45.2	16.4	10.0
8KMTT347	LT		53.5	44.1	15.7	9.6
Average			53.2	44.5	15.9	9.9
8KMTS357	Mid-		52.6	44.4	8.6	10.3
8KMTS358	Thick	325	53.1	43.9	10.0	9.0
8KMTS359	ST		53.8	44.9	8.6	9.2
Average			53.2	44.4	9.1	9.5
8KSTT375	Surface		47.2	(1)	12.8	(1)
8KSTT376	LT	400	47.9	39.9	12.1	10.0
8KSTT377			46.5	42.2	10.7	9.6
Average			47.2	41.6	11.8	9.8
8KQTT390	Quarter		48.2	40.2	16.4	10.0
8KQTT391	Thick	400	47.9	40.5	16.4	9.4
8KQTT392	LT		47.8	40.8	15.7	9.2
Average			47.9	40.5	16.2	9.5
8KMTT348	Mid-		48.2	41.6	(2)	8.8
8KMTT349	Thick	400	48.5	41.9	16.4	9.5
8KMTT350	LT		48.3	42.6	17.8	10.4
Average			48.3	42.0	17.1	9.6
8KMTS360	Mid-		46.9	40.3	(2)	10.0
8KMTS361	Thick	400	47.2	41.4	10.7	10.3
8KMTS362	ST		47.4	40.4	9.3	9.6
Average			47.2	40.7	10.0	9.9

(1) Extensometer malfunction.
(2) Failed near gage mark.

Table XVIII

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT 250°F
FROM SURFACE AND MID-THICKNESS OF 3" X 6-1/2" BILLET,
LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billet (a)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
6ASTL4		Surface	57.5	49.3	10.7	9.0
6ASTL5	A	L	57.5	49.3	9.3	9.0
6ASTL6			58.9	52.0	10.7	9.8
Average			58.0	50.2	10.2	9.3
6KSTL4		Surface	59.6	49.9	12.9	10.0
6KSTL5	K	L	59.6	49.7	12.9	10.9
6KSTL6			59.3	49.8	12.9	10.4
Average			59.5	49.8	12.9	10.4
6AMTL4		Mid-Thick	60.7	54.3	11.4	9.9
6AMTL5	A	L	61.6	53.9	9.3	10.8
6AMTL6			60.8	53.6	12.1	10.9
Average			61.0	53.6	10.9	10.5
6KMTL4		Mid-Thick	60.1	48.9	15.7	10.5
6KMTL5	K	L	59.1	47.5	13.5	10.5
6KMTL6			60.7	48.4	13.5	10.5
Average			60.0	48.3	14.2	10.5
6ASTT16		Surface	61.6	53.2	8.6	10.0
6ASTT17	A	LT	59.7	50.8	10.7	10.5
6ASTT18			60.4	52.6	10.0	11.1
Average			60.6	52.2	9.8	10.5
6KSTT16		Surface	59.4	49.5	7.1	11.0
6KSTT17	K	LT	58.8	49.8	5.7	10.9
6KSTT18			59.7	49.0	9.3	9.7
Average			59.3	49.4	7.4	10.5
6AMTT16		Mid-Thick	57.1	51.1	10.0	9.8
6AMTT17	A	LT	57.8	51.6	10.0	10.0
6AMTT18			58.3	52.3	10.0	9.7
Average			57.7	51.8	10.0	9.8
6KMTT16		Mid-Thick	57.7	50.1	10.0	10.6
6KMTT17	K	LT	58.0	48.3	8.6	11.7
6KMTT18			57.1	50.2	8.6	10.8
Average			57.6	49.5	9.1	11.0

Table XIX

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT 250°F FROM SURFACE, QUARTER-THICKNESS, AND MID-THICKNESS OF 4" X 8" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTION

Billet (b)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
8ASTL4		Surface	57.6	47.5	12.1	10.5
8ASTL5	A	L	57.1	47.5	13.6	11.2
8ASTL6			57.5	46.0	12.1	11.5
Average			57.4	47.0	12.6	11.1
8KSTL28		Surface	59.0	47.6	15.0	11.6
8KSTL29	K	L	58.5	50.0	15.0	11.5
8KSTL30			60.0	49.6	14.3	11.5
Average			59.1	49.0	14.8	11.5
8AQTL4		Quarter	57.0	47.1	13.6	10.4
8AQTL5	A	Thick	57.3	48.2	11.4	10.2
8AQTL6		L	57.6	49.2	11.4	10.4
Average			57.3	48.1	12.1	10.7
8KQTL28		Quarter	58.2	47.0	14.3	10.9
8KQTL29	K	Thick	59.4	48.3	14.3	10.4
8KQTL30		L	58.9	48.8	12.9	10.6
Average			58.8	48.0	13.8	10.6
8AMTL4		Mid-	59.7	49.6	10.7	11.5
8AMTL5	A	Thick	58.7	48.9	10.7	11.1
8AMTL6		L	58.7	48.9	10.7	11.1
Average			59.0	49.1	10.7	11.3
8KMTL40		Mid-	60.1	54.9	12.1	10.9
8KMTL41	K	Thick	59.9	51.0	11.4	10.6
8KMTL42		L	60.8	51.0	11.4	10.9
Average			60.2	52.3	11.6	10.8
8ASTT16		Surface	57.0	47.2	6.4	10.6
8ASTT17	A	LT	57.0	46.2	10.0	11.3
8ASTT18			57.1	46.4	6.4	11.6
Average			57.0	46.6	7.6	11.2
8KSTT40		Surface	58.5	47.6	11.4	10.5
8KSTT41	K	LT	58.6	47.0	10.0	11.2
8KSTT42			58.6	44.7	10.7	11.1
Average			58.5	46.4	10.7	10.9

Table XIX - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
8AQTT16		Quarter	56.0	48.2	9.3	(1)
8AQTT17	A	Thick	56.2	45.7	9.3	9.1
8AQTT18		LT	56.2	46.2	9.3	10.4
Average			56.1	46.7	9.3	9.8
8KQTT39		Quarter-	56.4	(1)	12.1	10.9
8KQTT40	K	Thick	57.3	46.4	10.0	10.6
8KQTT41		LT	58.2	47.7	9.3	10.6
Average			57.3	47.0	10.7	10.7
8AMTT16		Mid-	56.0	46.7	8.6	11.3
8AMTT17	A	Thick	56.0	46.3	7.9	11.3
8AMTT18		LT	56.1	46.5	11.4	11.3
Average			56.0	46.5	9.3	11.3
8KMTT52		Mid-	57.2	49.0	10.0	11.5
8KMTT53	K	Thick	57.0	48.6	7.9	11.1
8KMTT54		LT	57.7	49.9	9.3	11.5
Average			57.3	49.1	9.1	11.4
8AMTS28		Mid-	56.5	47.5	10.0	11.1
8AMTS29	A	Thick	55.6	47.9	5.0	9.8
8AMTS30		ST	57.3	49.7	5.7	11.2
Average			56.4	48.3	6.8	10.7
8KMTS64		Mid-	57.6	49.5	7.1	10.6
8KMTS65	K	Thick	54.1	46.9	3.6	11.1
8KMTS66		ST	56.6	47.6	8.6	10.4
Average			56.1	48.0	6.4	10.7

(1) Extensometer malfunction.

Table XX

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT 325°F
FROM SURFACE AND MID-THICKNESS OF 3" X 6-1/2" BILLET,
LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Specimen	Supplier	Billet Location	Billet (a) Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
6ASTL7		Surface	54.9	49.4	13.5	9.3
6ASTL8	A	L	55.5	51.2	15.0	9.9
6ASTL9			55.2	49.9	15.0	9.5
Average			55.2	50.2	14.5	9.6
6KSTL7		Surface	54.3	47.6	16.4	9.9
6KSTL8	K	L	54.9	49.0	16.4	10.6
6KSTL9			54.4	47.7	15.7	9.4
Average			54.5	48.1	16.2	10.0
6AMTL7		Mid-	55.8	51.3	13.5	9.8
6AMTL8	A	Thick	53.9	49.8	17.1	10.9
6AMTL9		L	55.9	51.8	13.5	10.2
Average			55.2	51.0	14.7	10.3
6KMTL7		Mid-	55.3	48.9	20.0	10.4
6KMTL8	K	Thick	54.6	47.4	17.1	10.5
6KMTL9		L	54.6	48.0	17.1	10.5
Average			54.8	48.1	18.1	10.5
6ASTT19		Surface	55.3	49.3	14.2	10.8
6ASTT20	A	LT	55.4	49.3	14.2	9.6
6ASTT21			55.7	50.5	10.7	9.5
Average			55.5	49.7	13.0	10.0
6KSTT19		Surface	54.1	45.6	13.6	9.4
6KSTT20	K	LT	54.6	46.4	10.0	10.1
6KSTT21			54.1	48.4	5.7	10.1
Average			54.3	46.8	9.8	9.9
6AMTT19		Mid-	53.4	49.6	13.5	10.8
6AMTT20	A	Thick	53.2	49.3	14.2	10.5
6AMTT21		LT	52.8	49.4	10.7	10.1
Average			53.1	49.4	12.8	10.5
6KMTT19		Mid-	53.8	46.3	10.7	10.8
6KMTT20	K	Thick	53.7	45.9	11.4	9.8
6KMTT21		LT	53.3	46.7	12.1	9.7
Average			53.6	46.3	11.4	10.1

Table XXI

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT 325°F FROM SURFACE, QUARTER-THICKNESS, AND MID-THICKNESS OF 4" X 8" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS

Billet (b)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
8ASTL7		Surface	53.1	45.4	15.7	10.5
8ASTL8	A	L	53.2	45.9	16.4	10.4
8ASTL9			53.2	46.4	17.1	10.5
Average			53.1	45.9	16.4	10.5
8KSTL31		Surface	54.9	48.8	15.7	10.6
8KSTL32	K	L	55.0	47.1	20.7	10.6
8KSTL33			54.2	47.1	17.1	10.6
Average			54.7	47.6	17.8	10.6
8AQTL7		Quarter	52.4	46.2	16.4	9.4
8AQTL8	A	Thick	52.9	46.0	15.7	8.4
8AQTL9		L	54.0	45.8	17.9	8.5
Average			53.1	46.0	16.7	8.8
8KQTL31		Quarter	56.3	48.3	12.1	8.5
8KQTL32	K	Thick	55.3	48.8	13.6	8.4
8KQTL33		L	55.6	48.5	15.0	9.2
Average			55.7	48.5	13.6	8.7
8AMTL7		Mid-Thick	53.6	47.0	15.7	10.9
8AMTL8	A	Thick	54.6	47.5	15.7	10.8
8AMTL9		L	52.6	46.1	15.7	10.5
Average			53.6	46.8	15.7	10.7
8KMTL43		Mid-	54.9	48.9	15.0	10.6
8KMTL44	K	Thick	55.7	47.9	16.4	10.2
8KMTL45		L	55.1	49.4	18.6	9.9
Average			55.2	48.7	16.7	10.2
8ASTT19		Surface	52.7	44.2	12.1	10.2
8ASTT20	A	LT	53.0	45.2	12.1	10.6
8ASTT21			51.8	45.1	12.1	10.9
Average			52.5	44.8	12.1	10.6
8KSTT43		Surface	54.1	46.2	15.0	10.6
8KSTT44	K	LT	54.0	46.2	16.4	10.6
8KSTT45			54.0	46.6	15.7	10.9
Average			54.0	46.3	15.7	10.7

Table XXI - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
8AQTT19		Quarter	52.6	43.7	15.0	9.3
8AQTT20	A	Thick	52.6	44.6	12.1	8.5
8AQTT21		LT	52.9	44.8	12.9	9.2
Average			52.7	44.4	13.3	9.0
8KQTT42		Quarter	54.7	46.0	12.9	9.0
8KQTT43	K	Thick	55.2	45.8	15.0	9.0
8KQTT44		LT	53.7	44.5	16.4	9.0
Average			54.5	45.4	14.8	9.0
8AMTT19		Mid-	52.1	45.5	12.1	10.8
8AMTT20	A	Thick	53.0	45.7	12.8	10.2
8AMTT21		LT	52.2	43.7	10.7	9.9
Average			52.4	44.9	11.9	10.3
8KMTT55		Mid-	53.4	46.6	13.6	9.9
8KMTT56	K	Thick	53.7	46.4	13.6	10.8
8KMTT57		LT	53.5	45.9	12.1	10.8
Average			53.5	46.3	13.1	10.5
8AMTS31		Mid-	52.6	46.4	6.0	9.8
8AMTS32	A	Thick	52.2	45.9	6.5	9.9
8AMTS33		ST	52.8	46.9	7.0	9.9
Average			52.5	46.4	6.5	9.9
8KMTS67		Mid-	52.8	45.0	13.6	10.5
8KMTS68	K	Thick	52.6	45.6	13.6	10.6
8KMTS69		ST	52.5	46.6	12.9	10.1
Average			52.6	45.7	13.3	10.4

Table XXII

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT 325°F FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 8" X 11" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS

Billet (c)

Specimen	Supplier	Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
11ASTL52			52.6	43.3	17.1	9.4
11ASTL53	A	Surface	54.8	45.0	17.5	9.6
11ASTL54		L	53.0	46.3	14.3	9.2
Average			53.5	44.9	16.3	9.4
11KSTL72			54.3	45.5	15.0	9.2
11KSTL73	K	Surface	53.1	46.1	(2)	9.3
11KSTL74		L	53.5	47.3	10.7	9.1
Average			53.6	46.3	12.8	9.2
11AQTL4		Quarter	53.1	45.0	15.7	8.8
11AQTL5	A	Thick	53.0	44.6	17.1	9.9
11AQTL6		L	53.5	44.9	17.1	8.5
Average			53.2	44.8	16.6	8.7
11KQTL31		Quarter	54.8	46.2	18.6	9.9
11KQTL32	K	Thick	56.0	47.0	15.7	9.0
11KQTL33		L	55.3	46.0	16.4	9.0
Average			55.4	46.4	16.9	9.3
11AMTL4		Mid-	53.7	44.1	15.7	9.1
11AMTL5	A	Thick	53.3	43.8	15.7	8.9
11AMTL6		L	53.7	45.2	16.1	9.5
Average			53.6	44.4	15.8	9.2
11KMTL31		Mid-	54.4	46.2	16.1	8.8
11KMTL32	K	Thick	55.0	47.2	15.7	8.3
11KMTL33		L	54.3	46.5	14.3	8.8
Average			54.6	46.6	15.4	8.6
11AQTT15		Quarter	52.2	43.1	13.6	9.0
11AQTT16	A	Thick(LT)	50.3	40.3	12.8	8.8
Average			51.8	41.7	13.2	8.9
11KQTT42		Quarter	55.5	47.4	9.3	9.4
11KQTT43	K	Thick(LT)	55.2	46.4	10.7	9.2
Average			55.4	46.9	10.0	9.3
11AMTT15		Mid-	52.6	44.0	12.1	9.0
11AMTT16	A	Thick(LT)	52.1	43.3	11.4	8.8
Average			52.4	43.7	11.8	8.9
11KMTT42		Mid-	(1)			
11KMTT43	K	Thick(LT)	53.7	45.5	10.7	8.0
Average			53.7	45.5	10.7	8.0

Table XXII - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
11ASTS64		Surface	53.7	42.5	12.1	9.4
11ASTS65	A	ST	53.2	42.4	10.0	8.5
Average			53.5	42.5	11.1	9.0
11KSTS84		Surface	55.5	46.8	10.7	8.8
11KSTS85	K	ST	54.4	[illegible]	11.4	9.4
Average			54.9	[illegible]	[illegible]	9.1
11AQTS24		Quarter	53.3	43[illegible]	[illegible]	8.8
11AQTS25	A	Thick(ST)	53.4	43.[illegible]	9.3	8.8
Average			53.4	43.2	10.4	8.8
11KQTS51		Quarter	55.3	47.0	9.3	9.2
11KQTS52	K	Thick(ST)	54.4	46.0	11.4	8.8
Average			54.9	46.5	10.4	9.0

(1) Bent Specimen.
(2) Failed near gage mark.

Table XXIII

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT 400°F FROM SURFACE AND MID-THICKNESS OF 3" X 6-1/2" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

			Billet (a)			
Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
6ASTL10		Surface	48.1	45.2	15.7	10.5
6ASTL11	A	L	48.6	44.9	17.0	8.8
6ASTL12			49.0	45.2	15.7	9.2
Average			48.6	45.1	16.0	9.5
6KSTL10		Surface	47.9	(1)	7.9 (2)	(1)
6KSTL11	K	L	48.5	43.0	16.4	9.4
6KSTL12			48.3	43.5	10.7	9.6
Average			48.2	43.3	13.5	9.5
6AMTL10		Mid-	47.5	44.9	17.0	9.2
6AMTL11	A	Thick	47.0	44.5	15.7	9.1
6AMTL12		L	47.2	44.9	15.0	9.1
Average			47.2	44.8	15.9	9.1
6KMTL10		Mid-	48.1	42.0	13.5	9.7
6KMTL11	K	Thick	48.7	43.3	15.0	9.1
6KMTL12		L	48.6	43.5	15.0	8.6
Average			48.5	42.9	14.5	9.1
6ASTT22		Surface	48.0	44.2	12.8	8.9
6ASTT23	A	LT	49.1	45.3	10.0	9.1
6ASTT24			47.2	45.2	7.9 (2)	8.4
Average			48.1	44.9	11.4	8.8
6KSTT22		Surface	48.1	41.7	4.0 (2)	8.1
6KSTT23	K	LT	48.0	42.1	10.7	7.9
6KSTT24			47.8	41.5	10.0	7.3
Average			48.0	41.8	10.3	7.8
6AMTT22		Mid-	46.4	44.0	16.4	8.7
6AMTT23	A	Thick	46.9	44.7	15.0	9.3
6AMTT24		LT	46.1	43.6	13.5	8.6
Average			46.5	44.1	14.9	8.9
6KMTT22		Mid-	47.4	41.7	12.0	8.7
6KMTT23	K	Thick	47.1	41.6	12.8	8.7
6KMTT24		LT	46.6	41.0	15.0	9.4
Average			47.0	41.4	13.2	8.9

(1) Extensometer malfunction.
(2) Failed in gage marks, not included in average.

Table XXIV

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT 400°F FROM SURFACE, QUARTER-THICKNESS, AND MID-THICKNESS OF 4" X 8" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS

Billet (b)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
8ASTL10		Surface	46.9	39.9	20.7	7.7
8ASTL11	A	L	46.5	40.9	18.6	7.6
8ASTL12			47.0	40.2	19.3	8.3
Average			46.8	40.3	19.5	7.9
8KSTL34		Surface	48.7	42.0	20.7	9.2
8KSTL35	K	L	50.1	[illegible].1	22.1	9.7
8KSTL36			49.8	42.8	22.1	8.8
Average			49.5	42.6	21.6	9.2
8AQTL10		Quarter	49.0	43.0	16.4	8.1
8AQTL11	A	Thick	48.4	41.6	16.4	8.1
8AQTL12		L	48.2	42.2	16.4	8.1
Average			48.5	42.2	16.4	8.1
8KQTL34		Quarter	48.0	(1)	15.0	(1)
8KQTL35	K	Thick	48.2	42.2	15.7	7.6
8KQTL36		L	48.3	43.4	15.7	8.1
Average			48.1	42.8	15.5	7.9
8AMTL10		Mid-	48.4	43.4	14.3	7.5
8AMTL11	A	Thick	48.2	40.8	14.3	7.3
8AMTL12		L	49.2	43.3	15.7	6.9
Average			48.6	42.5	14.8	7.2
8KMTL46		Mid-	50.2	45.0	18.6	7.2
8KMTL47	K	Thick	48.9	44.8	17.9	7.2
8KMTL48		L	49.4	44.8	17.1	7.2
Average			49.5	44.8	17.9	7.2
8ASTT22		Surface	47.8	41.0	12.1	7.6
8ASTT23	A	LT	47.3	40.6	15.0	7.2
8ASTT24			47.5	38.4	11.4	8.0
Average			47.5	40.0	12.8	7.6
8KSTT46		Surface	47.7	41.2	20.0	7.0
8KSTT47	K	LT	47.9	41.4	18.6	8.3
8KSTT48			47.3	40.9	17.9	9.2
Average			47.6	41.2	18.8	8.2

Table XXIV - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
8AQTT22		Quarter	46.3	41.7	12.9	9.2
8AQTT23	A	Thick	46.9	41.9	12.9	9.7
8AQTT24		LT	46.3	41.3	11.4	9.9
Average			46.5	41.6	12.4	9.6
8KQTT45		Quarter	48.0	41.7	13.6	9.6
8KQTT46	K	Thick	47.2	42.2	12.1	7.3
8KQTT47		LT	47.0	41.7	16.[illegible]	8.1
Average			47.4	41.8	14.0	7.7
8AMTT22		Mid-	46.1	41.5	14.3	9.2
8AMTT23	A	Thick	46.5	41.8	14.3	9.5
8AMTT24		LT	46.3	41.0	11.4	9.8
Average			46.3	41.4	13.3	9.5
8KMTT58		Mid-	48.9	(1)	13.6	(1)
8KMTT59	K	Thick	46.2	42.2	13.6	9.7
8KMTT60		LT	45.3	40.7	15.0	8.8
Average			46.8	41.4	14.1	9.3
8AMTS34		Mid-	47.6	41.6	12.1	7.0
8AMTS35	A	Thick	48.0	41.4	12.1	7.0
8AMTS36		ST	47.9	41.6	11.4	8.3
Average			47.8	41.5	11.9	7.4
8KMTS70		Mid-	48.4	41.4	13.6	8.0
8KMTS71	K	Thick	48.5	40.5	14.3	9.1
8KMTS72		ST	48.6	42.4	14.3	8.6
Average			48.5	41.4	14.1	8.6

(1) Extensometer Malfunction.

Table XXV

TENSILE PROPERTIES OF 2618 ALUMINUM ALLOY AT 400°F FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 8" X 11" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS

Billet (c)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
11ASTL55			47.5	42.5	16.4	10.0
11ASTL56	A	Surface	47.2	42.0	15.7	9.5
11ASTL57		L	47.8	41.5	18.6	8.7
Average			47.5	42.0	16.9	9.4
11KSTL75			48.8	43.2	11.4	8.7
11KSTL76	K	Surface	49.4	42.8	17.1	8.7
11KSTL77		L	48.9	42.6	12.8	8.3
Average			49.0	42.9	13.8	8.6
11AQTL7		Quarter	47.5	40.0	17.8	9.2
11AQTL8	A	Thick	49.4	41.2	17.1	8.8
11AQTL9		L	48.8	40.4	18.6	8.4
Average			48.6	40.5	17.8	8.8
11KQTL34		Quarter	49.6	42.5	16.4	8.8
11KQTL35	K	Thick	50.3	42.8	20.7	8.7
11KQTL36		L	50.1	43.0	16.4	8.7
Average			50.0	42.8	17.8	8.7
11AMTL7		Mid-	48.1	39.5	20.0	9.0
11AMTL8	A	Thick	48.0	39.3	18.6	9.4
11AMTL9		L	47.8	39.3	19.3	8.1
Average			48.0	39.4	19.3	8.8
11KMTL34		Mid-	47.8	41.6	17.8	9.4
11KMTL35	K	Thick	48.1	41.7	16.4	9.2
11KMTL36		L	48.3	41.4	16.4	8.8
Average			48.1	41.6	16.9	9.1
11AQTT17		Quarter	45.2	37.6	16.4	9.7
11AQTT18	A	Thick(LT)	44.6	36.2	17.8	8.8
Average			44.9	36.9	17.1	9.3
11KQTT44		Quarter	49.4	42.8	10.7	8.8
11KQTT45	K	Thick(LT)	48.5	42.7	15.7	9.8
Average			49.0	42.8	13.2	9.3
11AMTT17		Mid-	46.5	39.6	14.3	8.2
11AMTT18	A	Thick(LT)	46.1	39.4	12.8	9.4
Average			46.3	39.5	13.6	8.8

Table XXV - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation Percent	Modulus X 10^6 (Psi)
11KMTT44		Mid-	47.9	41.6	13.6	9.9
11KMTT45	K	Thick(LT)	47.5	39.4	13.6	9.7
Average			47.7	40.5	13.6	9.8
11ASTS66		Surface	47.2	38.6	12.8	9.8
11ASTS67	A	ST	47.2	38.7	12.1	8.0
Average			47.2	38.7	12.5	8.9
11KSTS86		Surface	49.2	42.5	12.8	9.0
11KSTS87	K	ST	51.2	44.2	12.1	9.8
Average			50.2	43.4	12.5	9.4
11AQTS26		Quarter	47.5	39.1	12.8	9.4
11AQTS27	A	Thick(ST)	46.8	38.8	12.8	9.4
Average			47.2	39.0	12.8	9.4
11KQTS53		Quarter	49.2	41.8	12.1	9.4
11KQTS54	K	Thick(ST)	48.9	41.2	12.1	9.0
Average			49.1	41.5	12.1	9.2

Table XXVI

NOTCHED TENSILE PROPERTIES, $K_t > 15$, OF 2618 ALUMINUM ALLOY
AT ROOM TEMPERATURE FROM SURFACE AND MID-THICKNESS
OF 3" X 6-1/2" BILLET,
LONGITUDINAL AND LONG TRANSVERSE DIRECTION

Billet (a)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	F_{tr}/F_{tu}
6ASNL52		Surface	48.9	.75
6ASNL53	A	L	54.5	.84
6ASNL54			55.4	.85
Average			52.9	.81
6KSNL52		Surface	45.2	.71
6KSNL53	K	L	50.0	.79
6KSNL54			49.6	.78
Average			48.3	.76
6AMNL25		Mid-	57.7	.89
6AMNL26	A	thick	55.8	.86
6AMNL27		L	58.1	.90
Average			57.2	.88
6KMNL25		Mid-	51.2	.80
6KMNL26	K	thick	51.0	.80
6KMNL27		L	49.7	.78
Average			50.6	.79
6ASNT61		Surface	51.4	.81
6ASNT62	A	LT	44.[illegible]	.70
6ASNT63			41.3	.65
Average			45.8	.72
6KSNT61		Surface	40.6	.66
6KSNT62	K	LT	37.2	.60
6KSNT63			36.7	.60
Average			38.2	.62
6AMNT34		Mid-	49.6	.80
6AMNT35	A	thick	53.4	.86
6AMNT36		LT	51.8	.84
Average			51.6	.83
6KMNT34		Mid-	42.6	.70
6KMNT35	K	thick	39.4	.65
6KMNT36		LT	40.2	.66
Average			40.7	.67

Table XXVII

NOTCHED TENSILE PROPERTIES, $K_t \gg 15$, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 4" x 8" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS
Billet (b)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{tu}/F_{tu}
8ASNL1		Surface	53.3	
8ASNL2	A	L	55.3	
8ASNL3			53.2	
Average			53.9	.885
8KSNL25		Surface	48.2	
8KSNL26	K	L	49.8	
8KSNL27			50.4	
Average			49.5	.791
8AQNL1		Quarter-	54.9	
8AQNL2	A	Thick	56.5	
8AQNL3		L	54.0	
Average			55.1	.924
8KQNL25		Quarter-	52.7	
8KQNL26	K	Thick	53.8	
8KQNL27		L	53.9	
Average			53.3	.868
8AMNL1		Mid-	62.2	
8AMNL2	A	Thick	55.7	
8AMNL3		L	55.7	
Average			57.9	.932
8KMNL37		Mid-	55.7	
8KMNL38	K	Thick	56.8	
8KMNL39		L	57.0	
Average			56.5	.891
8ASNT13		Surface	43.3	
8ASNT14	A	LT	48.0	
8ASNT15			45.2	
Average			45.5	.763
8KSNT37		Surface	43.8	
8KSNT38	K	LT	49.7	
8KSNT39			42.7	
Average			45.4	.736

Table XXVII - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{tn}/F_{tu}
8AQNT13		Quarter-	40.6	
8AQNT14	A	Thick	43.8	
8AQNT15		LT	40.6	
Average			41.7	.716
8KQNT37		Quarter-	47.1	
8KQNT38	K	Thick	45.1	
8KQNT39		LT	44.8	
Average			45.7	.757
8AMNT13		Mid-	49.7	
8AMNT14	A	Thick	51.2	
8AMNT15		LT	52.7	
Average			51.2	.869
8KMNT49		Mid-	51.3	
8KMNT50	K	Thick	49.3	
8KMNT51		LT	50.0	
Average			50.2	.842
8AMNS25		Mid-	47.4	
8AMNS26	A	Thick	47.6	
8AMNS27		ST	47.8	
Average			47.6	.807
8KMNS61		Mid-	46.8	
8KMNS62	K	Thick	47.8	
8KMNS63		ST	45.6	
Average			46.7	.778

Table XXVIII

NOTCHED TENSILE PROPERTIES, $K_t > 15$, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 8" x 11" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billet (c)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{tn}/F_{tu}
11ANSL1		Surface	55.6	
11ASNL2	A	L	55.0	
11ASNL3			55.1	
Average			55.2	.892
11KSNL19		Surface	55.3	
11KSNL20	K	L	55.7	
11KSNL21			55.3	
Average			55.4	.871
11AQNL1		Quarter-	54.7	
11AQNL2	A	Thick	53.5	
11AQNL3		L	54.3	
Average			54.3	.879
11KQNL28		Quarter-	54.2	
11KQNL29	K	Thick	53.2	
11KQNL30		L	53.9	
Average			53.8	.861
11AMNL1		Mid-	56.4	
11AMNL2	A	Thick	56.4	
11AMNL3		L	55.7	
Average			56.2	.926
11KMNL28		Mid-	54.4	
11KMNL29	K	Thick	54.6	
11KMNL30		L	57.2	
Average			55.4	.881
11ASNT10		Surface	48.2	
11ASNT11	A	LT	50.2	
11ASNT12			46.5	
Average			48.3	(1)
11KSNT29		Surface	42.6	
11KSNT30	K	LT	44.2	
11KSNT31			44.6	
Average			43.8	(1)

(1) No F_{tu} determined

Table XXVIII - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{tn}/F_{tu}
11AQNT10		Quarter-	46.0	
11AQNT11	A	Thick	46.9	
11AQNT12		LT	44.4	
Average			45.8	.801
11KQNT37		Quarter-	47.4	
11KQNT38	K	Thick	46.4	
11KQNT39		LT	47.1	
Average			47.0	.769
11AMNT10		Mid-	46.9	
11AMNT11	A	Thick	47.8	
11AMNT12		LT	47.2	
Average			47.3	.803
11KMNT37		Mid-	46.5	
11KMNT38	K	Thick	46.0	
11KMNT39		LT	49.0	
Average			47.2	.785

Table XXIX

NOTCHED TENSILE PROPERTIES, $K_t > 15$, OF 2618 ALUMINUM ALLOY AT 250°F FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 4" x 8" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS

Billet (b)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{tn}/F_{tu}
8ASNL4		Surface	49.2	
8ASNL5	A	L	51.1	
8ASNL6			52.9	
Average			51.1	.890
8KSNL28		Surface	46.2	
8KSNL29	K	L	43.1	
8KSNL30			48.3	
Average			45.9	.760
8AQNL4		Quarter-	53.6	
8AQNL5	A	Thick	49.7	
8AQNL6		L	[illegible]	
Average			52.1	.909
8KQNL28		Quarter-	[illegible]	
8KQNL29	K	Thick	50.8	
8KQNL30		L	48.0	
Average			50.6	.861
8AMNL4		Mid-	53.6	
8AMNL5	A	Thick	57.0	
8AMNL6		L	55.2	
Average			55.3	.937
8KMNL40		Mid-	[illegible]	
8KMNL41	K	Thick	51.8	
8KMNL42		L	52.4	
Average			52.7	.875
8ASNT16		Surface	42.5	
8ASNT17	A	LT	39.6	
8ASNT18			42.7	
Average			41.6	.720
8KSNT40		Surface	41.6	
8KSNT41	K	LT	39.7	
8KSNT42			41.7	
Average			41.0	.701

Table XXX-Continued

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{t_n}/F_{t_u}
8AQNT16		Quarter-	45.6	
8AQNT17	A	Thick	41.4	
8AQNT18		LT	46.3	
Average			44.4	.791
8KQNT40		Quarter-	41.8	
8KQNT41	K	Thick	42.6	
8KQNT42		LT	41.3	
Average			41.9	.731
8AMNT16		Mid-	46.6	
8AMNT17	A	Thick	44.1	
8AMNT18		LT	43.2	
Average			44.6	.796
8KMNT52		Mid-	48.6	
8KMNT53	K	Thick	48.4	
8KMNT54		LT	51.6	
Average			49.5	.864
8AMNS28		Mid-	46.8	
8AMNS29	A	Thick	46.8	
8AMNS30		ST	45.9	
Average			46.5	.824
8KMNS64		Mid-	46.5	
8KMNS65	K	Thick	46.0	
8KMNS66		ST	45.5	
Average			46.0	.820

Table XXX

NOTCHED TENSILE PROPERTIES, $K_t > 15$, OF 2618 ALUMINUM ALLOY
AT 325°F FROM SURFACE AND MID-THICKNESS OF
3" X 6-1/2" BILLET,
LONGITUDINAL AND TRANSVERSE DIRECTION
Billet (a)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	F_{tn}/F_{tu}
6ASNL55		Surface	55.3	.95
6ASNL56	A	L	54.7	.94
6ASNL57			55.5	.96
Average			55.2	.95
6KSNL55		Surface	45.3	.76
6KSNL56	K	L	46.8	.79
6KSNL57			46.6	.78
Average			46.2	.78
6AMNL28		Mid-thick	55.2	.91
6AMNL29	A		56.7	.93
6AMNL30		L	54.6	.90
Average			55.5	.91
6KMNL28		Mid-thick	49.9	.83
6KMNL29	K		46.9	.78
6KMNL30		L	50.2	.84
Average			49.0	.82
6ASTN64		Surface	43.0	.71
6ASTN65	A	LT	37.7	.62
6ASTN66			41.7	.69
Average			40.8	.67
6KSTN64		Surface	37.2	.63
6KSTN65	K	LT	36.7	.62
6KSTN66			38.1	.64
Average			37.3	.63
6AMNT37		Mid-thick	51.4	.89
6AMNT38	A		49.6	.86
6AMNT39		LT	50.0	.87
Average			50.3	.87
6KMNT37		Mid-thick	36.2	.63
6KMNT38	K		(1)	
6KMNT39		LT	40.4	.70
Average			38.3	.67

(1) Test machine malfunction.

Table XXXI

NOTCHED TENSILE PROPERTIES, $K_t > 15$, OF 2618 ALUMINUM ALLOY AT 325°F FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 4" x 8" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTION

Billet (b)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{t_n}/F_{t_u}
8ASNL7		Surface	47.9	
8ASNL8	A	L	48.9	
8ASNL9			49.8	
Average			48.9	.921
8KSNL31		Surface	46.4	
8KSNL32	K	L	51.2	
8KSNL33			48.9	
Average			48.8	.892
8AQNL7		Quarter-	49.4	
8AQNL8	A	Thick	49.5	
8AQNL9		L	50.3	
Average			49.7	.936
8KQNL31		Quarter-	47.4	
8KQNL32	K	Thick	49.1	
8KQNL33		L	49.8	
Average			48.8	.876
8AMNL7		Mid-	50.0	
8AMNL8	A	Thick	51.1	
8AMNL9		L	49.5	
Average			50.2	.937
8KMNL43		Mid-	50.3	
8KMNL44	K	Thick	50.6	
8KMNL45		L	51.9	
Average			50.9	.922
8ASNT19		Surface	41.1	
8ASNT20	A	LT	44.2	
8ASNT21			43.7	
Average			43.0	.819
8KSNT43		Surface	39.4	
8KSNT44	K	LT	39.4	
8KSNT45			38.2	
Average			39.0	.722
8AQNT19		Quarter-	41.8	
8AQNT20	A	Thick	41.6	
8AQNT21		LT	40.8	
Average			41.4	.766

Table XXXI (continued)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{tn}/F_{tu}
8KQNT43		Quarter-	43.8	
8KQNT44	K	Thick	42.5	
8KQNT45		LT	42.2	
Average			42.8	.785
8AMNT19		Mid-	44.2	
8AMNT20	A	Thick	46.2	
8AMNT21		LT	46.6	
Average			45.6	.870
8KMNT55		Mid-	46.6	
8KMNT56	K	Thick	46.0	
8KMNT57		LT	46.5	
Average			46.4	.867
8AMNS31		Mid-	(1)	
8AMNS32	A	Thick	46.1	
8AMNS33		ST	45.9	
Average			46.0	.876
8KMNS67		Mid-	47.0	
8KMNS68	K	Thick	48.1	
8KMNS69		ST	49.5	
Average			48.2	.916

(1) Failed in loading pin hole.

Table XXXII

NOTCHED TENSILE PROPERTIES, $K_t > 15$, OF 2618 ALUMINUM ALLOY AT 325°F FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 8" x 11" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billet (c)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{tn}/F_{tu}
11ASNL4		Surface	51.5	
11ASNL5	A	L	50.0	
11ASNL6			51.8	
Average			51.1	.957
11KSNL22		Surface	50.6	
11KSNL23	K	L	49.2	
11KSNL24			49.8	
Average			49.9	.931
11AQNL4		Quarter-	53.1	
11AQNL5	A	Thick	51.8	
11AQNL6		L	49.1	
Average			51.3	.964
11KQNL31		Quarter-	51.3	
11KQNL32	K	Thick	51.5	
11KQNL33		L	50.6	
Average			51.1	.922
11AMNL4		Mid-	53.1	
11AMNL5	A	Thick	51.9	
11AMNL6		L	52.0	
Average			52.3	.976
11KMNL31		Mid-	52.5	
11KMNL32	K	Thick	52.7	
11KMNL33		L	51.9	
Average			52.4	.960
11ASNT13		Surface	43.9	
11ASNT14	A	LT	44.5	
11ASNT15			45.5	
Average			44.6	(1)
11KSNT32		Surface	40.2	
11KSNT33	K	LT	46.8	
11KSNT34			43.7	
Average			43.6	(1)

TABLE XXXII (continued)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{t_n}/F_{t_u}
11AQNT13		Quarter-	43.6	
11AQNT14	A	Thick	44.8	
11AQNT15		LT	46.1	
Average			44.8	.865
11KQNT40		Quarter-	45.6	
11KQNT41	K	Thick	45.7	
11KQNT42		LT	48.7	
Average			46.[illegible]	.843
11AMNT13		Mid-	45.1	
11AMNT14	A	Thick	46.6	
11AMNT15		LT	44.0	
Average			45.2	.863
11KMNT40		Mid-	47.2	
11KMNT41	K	Thick	45.3	
11KMNT42		LT	50.5	
Average			47.7	.888

(1) No F_{tu} Determined

Table XXXIII

NOTCHED TENSILE PROPERTIES, $K_t > 15$, OF 2618 ALUMINUM ALLOY AT 400°F FROM SURFACE AND MID-THICKNESS OF 3" X 6-1/2" BILLET, LONGITUDINAL AND TRANSVERSE DIRECTION
Billet (s)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)	F_{tn}/F_{tu}
6ASNL58		Surface	55.0	1.13
6ASNL59	A	L	49.4	1.00
6ASNL60			50.2	1.03
Average			51.5	1.06
6KSNL58		Surface	48.8	1.01
6KSNL59	K	L	46.9	.97
6KSNL60			47.6	.99
Average			47.8	.99
6AMNL31		Mid-thick	48.3	1.02
6AMNL32	A		47.4	1.00
6AMNL33		L	48.4	1.03
Average			48.0	1.02
6KMNL31		Mid-thick	45.3	.93
6KMNL32	K		45.3	.93
6KMNL33		L	46.1	.95
Average			45.6	.940
6ASNT67		Surface	46.9	.98
6ASNT68	A	LT	46.9	.98
6ASNT69			46.8	.97
Average			46.9	.98
6KSNT67		Surface	42.7	.89
6KSNT68	K	LT	42.0	.88
6KSNT69			40.9	.85
Average			41.9	.87
6AMNT40		Mid-thick	47.0	1.01
6AMNT41	A		46.7	1.00
6AMNT42		LT	47.7	1.03
Average			47.1	1.01
6KMNT40		Mid-thick	40.7	.87
6KMNT41	K		42.4	.90
6KMNT42		LT	41.6	.89
Average			41.6	.89

Table XXXIV

NOTCHED TENSILE PROPERTIES, $K_t > 15$, OF 2618 ALUMINUM ALLOY AT 400°F FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 4" x 8" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTION

Billet (b)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{t_n}/F_{t_u}
8ASNL10		Surface	45.5	
8ASNL11	A	L	45.1	
8ASNL12			45.9	
Average			45.5	.972
8KSNL34		Surface	43.7	
8KSNL35	K	L	43.7	
8KSNL36			47.3	
Average			44.9	.907
8AQNL10		Quarter-	46.1	
8AQNL11	A	Thick	46.2	
8AQNL12		L	46.2	
Average			46.2	.952
8KQNL34		Quarter-	45.7	
8KQNL35	K	Thick	45.7	
8KQNL36		L	(1)	
Average			45.7	.950
8AMNL10		Mid-	44.3	
8AMNL11	A	Thick	45.5	
8AMNL12		L	48.5	
Average			46.1	.948
8KMNL46		Mid-	48.3	
8KMNL47	K	Thick	47.5	
8KMNL48		L	45.5	
Average			47.1	.951
8ASNT22		Surface	43.5	
8ASNT23	A	LT	43.9	
8ASNT24			42.8	
Average			43.4	.913
8KSNT46		Surface	42.0	
8KSNT47	K	LT	45.0	
8KSNT48			42.9	
Average			43.3	.909

Table XXXIV - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{tn}/F_{tu}
8AQNT22		Quarter-	40.1	
8AQNT23	A	Thick	41.8	
8AQNT24		LT	43.2	
Average			41.7	.897
8KQNT46		Quarter-	42.1	
8KQNT47	K	Thick	41.9	
8KQNT48		LT	43.0	
Average			42.3	.892
8AMNT22		Mid-	43.0	
8AMNT23	A	Thick	45.4	
8AMNT24		LT	44.2	
Average			44.2	.955
8KMNT58		Mid-	45.0	
8KMNT59	K	Thick	45.3	
8KMNT60		LT	45.0	
Average			45.1	.964
8AMNS34		Mid-	45.5	
8AMNS35	A	Thick	45.2	
8AMNS36		ST	45.2	
Average			45.3	.948
8KMNS70		Mid-	46.2	
8KMNS71	K	Thick	46.5	
8KMNS72		ST	45.4	
Average			46.0	.948

(1) Specimen missing.

TABLE XXXV

NOTCHED TENSILE PROPERTIES, $K_t > 15$, OF 2618 ALUMINUM ALLOY AT 400°F FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 8" x 11" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billet (c)

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{t_n}/F_{t_u}
11ASNL7		Surface	47.0	
11ASNL8	A	L	47.2	
11ASNL9			45.9	
Average			46.7	.983
11KSNL25		Surface	46.7	
11KSNL26	K	L	46.8	
11KSNL27			47.8	
Average			47.1	.961
11AQNL7		Quarter-	47.5	
11AQNL8	A	Thick	45.5	
11AQNL9		L	46.6	
Average			46.5	.957
11KQNL34		Quarter-	45.7	
11KQNL35	K	Thick	47.3	
11KQNL36		L	47.2	
Average			46.7	.934
11AMNL7		Mid-	46.4	
11AMNL8	A	Thick	46.7	
11AMNL9		L	47.4	
Average			46.8	.975
11KMNL34		Mid-	48.1	
11KMNL35	K	Thick	47.8	
11KMNL36		L	45.6	
Average			47.2	.981
11ASNT16		Surface	43.8	
11ASNT17	A	LT	42.9	
11ASNT18			44.0	
Average			43.6	(1)
11KSNT35		Surface	43.2	
11KSNT36	K	LT	46.3	
11KSNT37			46.0	
Average			45.2	(1)

Table XXV - Continued

Specimen	Supplier	Billet Location	Ultimate Strength (KSI)	F_{t_n}/F_{t_u}
11AQNT16		Quarter-	43.8	
11AQNT17	A	Thick	43.9	
11AQNT18		LT	43.0	
Average			43.6	.971
11KQNT43		Quarter-	44.8	
11KQNT44	K	Thick	44.4	
11KQNT45		LT	44.5	
Average			44.6	.910
11AMNT16		Mid-	42.1	
11AMNT17	A	Thick	43.6	
11AMNT18		LT	42.4	
Average			42.7	.922
11KMNT43		Mid-	46.2	
11KMNT44	K	Thick	45.9	
11KMNT45		LT	45.0	
Average			45.7	.958

(1) No F_{t_u} determined

Table XXXVI

THERMAL STABILITY OF 2618 ALUMINUM ALLOY EXPOSED
AT 325°F AND 400°F FOR 100 AND 1000 HOURS,
SURFACE MATERIAL FROM 3" X 6-1/2" BILLET,
LONGITUDINAL DIRECTION
Billet (a)

Specimen	Supplier	Exposure Temp.(°F)	Exposure Time(Hr.)	Test Temp. (°F)	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation(%)
6ASTL79					66.1	55.9	6.4
6ASTL80	A	325	100	RT	61.3	52.6	5.0
6ASTL81					65.7	55.9	7.1
Average					64.4	54.8	6.2
6KSTL79					65.1	53.8	8.6
6KSTL80	K	325	100	RT	65.3	53.4	7.1
6KSTL81					65.7	53.4	9.3
Average					65.4	53.5	8.3
6ASTL82					62.4	53.7	7.9
6ASTL83	A	325	1000	RT	63.0	52.5	8.6
6ASTL84					61.3	55.7	8.6
Average					62.2	54.0	8.4
6KSTL82					60.6	54.4	8.6
6KSTL83	K	325	1000	RT	60.8	53.7	9.3
6KSTL84					60.8	54.1	7.9
Average					60.7	54.1	8.6
6ASTL91					56.5	54.0	12.9
6ASTL92	A	325	100	325	56.2	53.1	15.7
6ASTL93					56.4	52.6	15.0
Average					56.4	53.2	14.5
6KSTL91					55.7	50.7	17.1
6KSTL92	K	325	100	325	55.6	50.4	15.0
6KSTL93					55.7	49.6	17.9
Average					55.7	50.2	16.7
6ASTL100					49.8	(1)	10.0
6ASTL101	A	325	1000	325	53.8	50.7	4.0
6ASTL102					54.3	(1)	10.0
Average					52.6	50.7	8.0
6KSTL100					50.7	47.0	20.0
6KSTL101	K	325	1000	325	51.9	47.9	15.7
6KSTL102					54.0	50.7	14.0
Average					52.2	48.5	16.6

(1) Extensometer malfunction.

Table XXXVI - Continued:

Specimen	Supplier	Exposure Temp.(°F)	Exposure Time(Hr.)	Test Temp. (°F)	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation(%)
6ASTL85					62.7	54.9	6.4
6ASTL86	A	400	100	RT	62.6	54.9	6.4
6ASTL87					62.1	54.6	6.4
Average					62.5	54.8	6.4
6KSTL85					59.9	50.9	8.6
6KSTL86	K	400	100	RT	59.8	50.9	8.6
6KSTL87					59.6	50.3	8.6
Average					59.8	50.7	8.6
6ASTL88					54.7	43.1	9.3
6ASTL89	A	400	1000	RT	54.4	44.0	10.0
6ASTL90					55.0	45.1	9.3
Average					54.7	44.1	9.5
6KSTL88					52.7	40.7	9.3
6KSTL89	K	400	1000	RT	52.7	40.7	9.3
6KSTL90					52.8	40.7	10.0
Average					52.7	40.7	9.5
6ASTL94					46.2	43.5	12.1
6ASTL95	A	400	100	400	45.6	42.7	12.1
6ASTL96					45.2	43.2	19.3
Average					45.7	43.1	14.5
6KSTL94					43.0	40.9	16.5
6KSTL95	K	400	100	400	46.8	40.5	13.6
6KSTL96					43.5	39.9	19.3
Average					44.4	40.4	16.4
6ASTL97					40.2	36.5	19.0
6ASTL98	A	400	1000	400	39.0	35.2	19.0
6ASTL99					38.9	35.3	24.0
Average					39.4	35.6	20.6
6KSTL97					37.6	34.3	18.8
6KSTL98	K	400	1000	400	37.9	34.3	17.8
6KSTL99					38.1	34.8	19.0
Average					37.9	34.5	18.5

(1) Extensometer malfunction.

TABLE XXXVII

THERMAL STABILITY OF 2618 ALUMINUM ALLOY
EXPOSED AT 250°F FOR 10, 100 AND 1000 HOURS AND
TESTED AT ROOM TEMPERATURE, SURFACE AND MID-THICKNESS
MATERIAL FROM 4" x 8" BILLET, LONGITUDINAL AND
LONG TRANSVERSE DIRECTIONS

Billets (b) and (d) (1)

Specimen	Supplier	Billet Location	Exposure Time (Hrs)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
8ASTL49		Surface		61.9	49.4	11.7
8ASTL50	A	L	10	62.0	49.9	11.1
8ASTL51				61.8	49.7	11.1
Average				61.9	49.7	11.3
8KSTL157		Surface		63.2	51.2	10.5
8KSTL158	K	L	10	62.6	50.8	10.1
8KSTL159				63.5	51.5	11.0
Average				63.1	51.2	10.5
8AMTL75		Mid-		62.7	52.2	9.9
8AMTL76	A	Thick	10	61.5	50.4	9.9
8AMTL77		L		60.9	50.1	9.9
Average				61.7	50.8	9.9
8KMTL130		Mid-		63.0	50.7	9.9
8KMTL131	K	Thick	10	63.6	51.8	9.9
8KMTL132		L		62.7	51.0	9.4
Average				63.1	51.2	9.7
8ASTT130		Surface		59.9	48.6	6.8
8ASTT131	A	LT	10	59.9	49.9	4.8
8ASTT132				60.2	48.8	6.1
Average				60.0	49.1	5.9
8KSTT238		Surface		62.2	49.2	8.6
8KSTT239	K	LT	10	62.3	50.4	8.6
8KSTT240				62.0	49.5	9.3
Average				62.2	49.7	8.8
8ASTL58		Surface		60.4	46.0	11.4
8ASTL59	A	L	100	61.1	49.0	9.5
8ASTL60				61.6	49.0	9.5
Average				61.0	48.0	10.1
8KSTL166		Surface		62.5	50.4	9.3
8KSTL167	K	L	100	61.4	49.2	10.0
8KSTL168				61.3	48.9	9.3
Average				61.7	49.5	9.5
8AMTL93		Mid-		60.6	50.6	8.7
8AMTL94	A	Thick	100	61.4	50.4	9.7
8AMTL95		L		60.0	50.0	8.7
Average				60.7	50.3	9.0

Table XXXVII - Continued

Specimen	Supplier	Billet Location	Exposure Time (Hr)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
8KMTL148		Mid-		64.1	52.3	10.6
8KMTL149	K	Thick	100	63.0	50.7	10.6
8KMTL150		L		62.1	50.0	10.6
Average				63.1	51.0	10.6
8ASTT112		Surface		60.0	48.2	6.4
8ASTT113	A	LT	100	59.8	47.6	6.4
8ASTT114				60.0	47.5	7.2
Average				59.9	47.8	6.7
8KSTT220		Surface		62.3	49.9	7.9
8KSTT221	K	LT	100	62.9	50.6	9.3
8KSTT222				62.6	50.6	8.6
Average				62.6	50.4	8.6
8ASTL67		Surface		63.3	51.8	9.3
8ASTL68	A	L	1000	63.3	51.9	9.3
8ASTL69				62.9	51.2	10.0
Average				63.2	51.6	9.5
8KSTL175		Surface		63.3	52.4	9.3
8KSTL176	K	L	1000	64.7	53.9	9.3
8KSTL177				64.1	53.1	9.3
Average				64.0	53.1	9.3
8KMTL318		Mid-		62.3	50.1	11.4
8KMTL319	K (1)	Thick	1000	62.2	49.1	12.1
8KMTL320		L		61.7	48.9	12.1
Average				62.1	49.7	11.8
8KMTL321		Mid-		61.5	49.2	11.4
8KMTL322	K (1)	Thick	1000	61.3	48.7	10.7
8KMTL323		L		61.4	49.2	[illegible]
Average				61.4	49.1	[illegible]
8ASTT121		Surface		61.4	48.2	5.7
8ASTT122	A	LT	1000	61.1	48.7	6.4
8ASTT123				62.0	51.2	7.1
Average				61.5	49.4	6.4
8KSTT229		Surface		63.8	56.9	8.6
8KSTT230	K	LT	1000	63.6	53.0	6.4
8KSTT231				63.6	52.9	8.6
Average				63.7	54.3	7.9

(1) Specimens removed from Billet (d); all other specimens from Billet (b).

Table XXXVIII

THERMAL STABILITY OF 2618 ALUMINUM ALLOY
EXPOSED AT 325°F FOR 10, 100 AND 1000 HOURS AND
TESTED AT ROOM TEMPERATURE, SURFACE AND MID-THICKNESS
MATERIAL FROM 4" X 8" BILLET, LONGITUDINAL AND
LONG TRANSVERSE DIRECTIONS

Billets (b) and (d) (1)

Specimen	Supplier	Billet Location	Exposure Time (Hrs)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
8ASTL52	A	Surface		61.6	49.8	9.9
8ASTL53		L	10	61.2	49.3	9.4
8ASTL54				61.6	49.4	8.4
Average				61.5	49.5	9.2
8KSTL160		Surface		63.4	50.9	9.3
8KSTL161	K	L	10	63.0	50.9	10.0
8KSTL162				62.6	50.7	9.3
Average				63.0	50.8	9.5
8AMTL78		Mid-		60.3	50.0	11.0
8AMTL79	A	Thick	10	63.5	53.4	8.9
8AMTL80		L		61.5	50.5	9.7
Average				61.8	51.3	9.9
8KMTL133		Mid-		63.4	52.0	9.0
8KMTL134	K	Thick	10	63.6	52.0	9.4
8KMTL135		L		62.9	51.3	8.7
Average				63.3	51.8	9.0
8ASTT106		Surface		60.8	49.4	6.4
8ASTT107	A	LT	10	59.5	49.2	5.0
8ASTT108				59.7	48.8	5.7
Average				60.0	49.1	5.7
8KSTT214		Surface		62.7	50.2	8.6
8KSTT215	K	LT	10	63.1	54.1	9.3
8KSTT216				62.2	50.0	8.6
Average				62.7	51.4	8.8
8ASTL61		Surface		62.1	51.5	8.3
8ASTL62	A	L	100	62.6	51.3	8.3
8ASTL63				62.9	51.7	8.3
Average				62.5	51.5	8.3
8KSTL169		Surface		63.5	53.4	7.9
8KSTL170	K	L	100	63.8	53.1	7.9
8KSTL171				62.9	52.9	7.9
Average				63.4	53.1	7.9

Table XXXVIII - Continued

Specimen	Supplier	Billet Location	Exposure Time (Hrs)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
8AMTL96		Mid-		62.1	52.6	9.2
8AMTL97	A	Thick	100	62.0	51.9	9.2
8AMTL98		L		61.8	52.0	9.3
Average				62.0	52.2	9.2
8KMTL151		Mid-		63.4	52.5	9.9
8KMTL152	K	Thick	100	63.8	52.8	9.2
8KMTL153		L		63.5	52.5	9.3
Average				63.6	52.6	9.5
8ASTT115		Surface		61.9	51.9	7.3
8ASTT116	A	LT	100	61.2	52.0	4.7
8ASTT117				60.8	50.3	6.8
Average				61.3	51.4	6.3
8KSTT223		Surface		63.9	53.2	9.3
8KSTT224	K	LT	100	63.3	52.6	6.4
8KSTT225				63.4	52.9	7.1
Average				63.5	52.9	7.6
8ASTL70		Surface		59.2	51.9	9.3
8ASTL71	A	L	1000	59.6	52.2	9.3
8ASTL72				59.2	51.9	8.6
Average				59.3	52.0	9.1
8KSTL178		Surface		60.4	53.4	9.3
8KSTL179	K	L	1000	61.2	54.1	9.3
8KSTL180				61.5	54.5	8.6
Average				61.0	54.0	9.1
8KMTL324		Mid-		57.3	48.2	10.0
8KMTL325	K (1)	Thick	1000	57.2	48.5	10.0
8KMTL326		L		56.0	47.2	9.3
Average				56.8	47.9	9.7
8KMTL327		Mid-		56.5	46.2	10.0
8KMTL328	K (1)	Thick	1000	57.8	47.0	10.0
8KMTL329		L		57.5	49.2	9.3
Average				57.3	47.5	9.7
8ASTT124		Surface		59.4	52.8	6.4
8ASTT125	A	LT	1000	59.5	52.9	7.1
8ASTT126				59.6	52.8	5.7
Average				59.5	52.8	6.4
8KSTT232		Surface		60.8	53.6	8.6
8KSTT233	K	LT	1000	60.7	53.5	9.3
8KSTT234				61.3	54.3	9.3
Average				60.9	53.8	9.1

(1) Specimens removed from Billet (d); all other specimens from Billet (b).

Table XXXIX

THERMAL STABILITY OF 2618 ALUMINUM ALLOY EXPOSED AT 400°F FOR 10,100 AND 1,000 HOURS AND TESTED AT ROOM TEMPERATURE, SURFACE AND MID-THICKNESS MATERIAL FROM 4" x 8" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS
Billets (b) and (d) (1)

Specimen	Supplier	Billet Location	Exposure Time (Hr)	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation (%)
8ASTL55		Surface		60.1	52.6	8.4
8ASTL56	A	L	10	60.1	52.8	9.7
8ASTL57				60.6	53.1	9.4
Average				60.2	52.8	9.2
8KSTL163		Surface		62.2	51.9	8.6
8KSTL164	K	L	10	62.6	51.6	9.3
8KSTL165				61.6	50.8	9.3
Average				62.1	51.4	9.1
8AMTL81		Mid-		58.2	50.8	9.4
8AMTL82	A	Thick	10	57.7	50.0	9.2
8AMTL83		L		58.0	50.0	10.4
Average				58.0	50.3	9.7
8KMTL136		Mid-		60.9	53.2	9.4
8KMTL137	K	Thick	10	60.9	53.5	8.9
8KMTL138		L		61.9	54.7	9.2
Average				61.2	53.8	9.2
8ASTT109		Surface		59.1	52.4	5.9
8ASTT110	A	LT	10	59.0	52.7	4.5
8ASTT111				59.7	53.3	4.5
Average				59.3	52.8	5.0
8KSTT217		Surface		61.8	54.9	9.3
8KSTT218	K	LT	10	61.2	52.7	8.6
8KSTT219				62.1	53.4	8.6
Average				61.7	53.7	8.8
8ASTL64		Surface		56.2	46.9	10.7
8ASTL65	A	L	100	55.1	45.5	9.9
8ASTL66				55.3	45.9	9.9
Average				55.5	46.1	10.2
8KSTL172		Surface		60.5	52.9	8.6
8KSTL173	K	L	100	61.0	53.1	9.3
8KSTL174				60.3	52.9	8.6
Average				60.6	53.0	8.8
8AMTL99		Mid-		53.7	44.3	9.0
8AMTL100	A	Thick	100	56.0	47.0	10.4
8AMTL101		L		55.2	46.1	10.4
Average				55.0	45.8	9.9

Table XXXIX - (Continued)

Specimen	Supplier	Billet Location	Exposure Time (Hr)	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation (%)
8KMTL154		Mid-		56.0	46.5	10.4
8KMTL155	K	Thick	100	56.3	46.7	10.0
8KMTL156		L		56.2	46.9	10.0
Average				56.2	46.7	10.1
8ASTT118		Surface		55.4	46.5	8.2
8ASTT119	A	LT	100	55.4	46.5	8.3
8ASTT120				54.7	45.6	7.9
Average				55.2	46.2	8.1
8KSTT226		Surface		59.6	53.1	8.6
8KSTT227	K	LT	100	60.5	53.6	8.6
8KSTT228				60.5	54.6	8.6
Average				60.2	53.8	8.6
8ASTL73		Surface		51.7	41.0	10.0
8ASTL74	A	L	1000	51.6	40.8	10.0
8ASTL75				51.8	40.6	10.0
Average				51.7	40.8	10.0
8KSTL181		Surface		51.2	39.7	9.3
8KSTL182	K	L	1000	52.0	40.5	10.7
8KSTL183				52.0	40.6	10.0
Average				51.7	40.3	10.0
8KMTL330	(1)	Mid-		48.6	34.5	11.4
8KMTL331	K	Thick	1000	48.2	34.5	11.4
8KMTL332		L		49.2	34.2	11.4
Average				48.7	34.2	11.4
8KMTL333	(1)	Mid-		48.2	33.9	12.1
8KMTL334	K	Thick	1000	49.2	34.7	12.8
8KMTL335		L		48.5	34.1	12.1
Average				48.6	34.2	12.3
8ASTT127		Surface		51.6	40.8	7.9
8ASTT128	A	LT	1000	51.1	40.5	7.9
8ASTT129				50.9	40.2	8.6
Average				51.2	40.5	8.1
8KSTT235		Surface		50.6	39.7	10.0
8KSTT236	K	LT	1000	51.7	40.2	10.0
8KSTT237				51.3	40.0	10.0
Average				51.2	40.0	10.0

(1) Specimens removed from 4" x 8" billet (d).

Table XI

THERMAL STABILITY OF 2618 ALUMINUM ALLOY EXPOSED AT 250°F
FOR 10, 100 AND 1000 HOURS AND TESTED AT 250°F, SURFACE
AND MID-THICKNESS MATERIAL FROM 4" x 8" BILLET
LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS
Billets (b) and (d) (1)

Specimen	Supplier	Billet Location	Exposure Time (Hr)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
8ASTL76		Surface		57.8	47.6	12.9
8ASTL77	A	L	10	57.9	47.7	12.9
8ASTL78				57.6	47.3	13.1
Average				57.8	47.5	13.1
8KSTL184		Surface		58.6	49.8	8.6
8KSTL185	K	L	10	59.1	49.9	13.6
8KSTL186				58.4	50.3	10.7
Average				58.7	50.0	11.0
8AMTL84		Mid-		56.4	46.5	10.7
8AMTL85	A	Thick	10	56.0	47.3	10.7
8AMTL86		L		56.3	46.6	10.7
Average				56.2	46.8	10.7
8KMTL139		Mid-		59.4	49.0	11.4
8KMTL140	K	Thick	10	58.7	48.8	12.9
8KMTL141		L		58.1	46.9	13.6
Average				58.7	48.2	12.6
8ASTT103		Surface		57.5	46.9	10.7
8ASTT104	A	LT	10	56.5	46.4	7.1
8ASTT105				56.8	46.8	9.3
Average				56.9	46.7	9.0
8KSTT211		Surface		58.8	50.0	11.4
8KSTT212	K	LT	10	58.9	50.3	7.8
8KSTT213				58.6	49.9	9.3
Average				58.8	50.1	9.5
8ASTL85		Surface		58.2	48.1	13.6
8ASTL86	A	L	100	57.4	46.0	[illegible]
8ASTL87				57.3	45.4	[illegible]
Average				57.6	46.5	[illegible]
8KSTL193		Surface		58.3	48.4	10.7
8KSTL194	K	L	100	59.0	46.2	9.3
8KSTL195				58.8	49.2	13.6
Average				58.7	47.9	11.2
8AMTL102		Mid-		56.4	48.2	12.1
8AMTL103	A	Thick	100	56.7	48.1	12.1
8AMTL104		L		56.6	47.7	11.4
Average				56.6	48.0	11.9

Table XL - Continued

Specimen	Supplier	Billet Location	Exposure Time (Hrs)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
8KMTL157		Mid-		59.4	48.4	13.6
8KMTL158	K	Thick	100	58.4	49.3	12.9
8KMTL159		L		57.9	47.3	13.6
Average				58.6	48.3	13.4
8ASTT139		Surface		57.4	46.2	8.6
8ASTT140	A	LT	100	57.2	46.9	7.1
8ASTT141				57.5	46.4	10.0
Average				57.4	46.5	8.6
8KSTT247		Surface		58.7	48.7	7.1
8KSTT248	K	LT	100	58.6	47.8	12.1
8KSTT249				58.6	48.3	7.1
Average				58.6	48.3	8.8
8ASTL94		Surface		60.1	51.1	12.9
8ASTL95	A	L	1000	58.6	49.5	12.9
8ASTL96				58.7	50.1	13.6
Average				59.1	50.2	13.1
8KSTL202		Surface		60.7	54.1	8.6
8KSTL203	K	L	1000	61.2	53.6	12.1
8KSTL204				61.1	52.7	5.7
Average				61.0	53.5	8.8
8KMTL300		Mid-		58.5	47.1	9.3
8KMTL301	K (1)	Thick	1000	57.4	46.4	11.4
8KMTL302		L		57.9	46.4	11.4
Average				57.9	46.6	10.7
8KMTL303		Mid-		57.3	47.5	10.7
8KMTL304	K (1)	Thick	1000	60.9	51.4	16.4
8KMTL305		L		61.0	49.2	14.3
Average				59.7	49.4	13.8
8ASTT148		Surface		58.3	47.7	6.4
8ASTT149	A	LT	1000	58.3	50.2	6.4
8ASTT150				57.9	48.9	6.4
Average				58.2	48.9	6.4
8KSTT256		Surface		62.3	53.0	5.7
8KSTT257	K	LT	1000	57.5	51.5	2.9
8KSTT258				61.3	52.7	9.3
Average				60.4	52.4	6.0

(1) Specimens removed from Billet (d); all other specimens from Billet (b).

Table XLI

THERMAL STABILITY OF 2618 ALUMINUM ALLOY EXPOSED AT 325°F FOR 10, 100 AND 1000 HOURS AND TESTED AT 325°F, SURFACE AND MID-THICKNESS MATERIAL FROM 4" x 8" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS
Billets (b) and (d) (1)

Specimen	Supplier	Billet Location	Exposure Time (Hr)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
8ASTL79		Surface		53.0	44.7	17.1
8ASTL80	A	L	10	53.4	44.8	16.4
8ASTL81				53.6	44.9	15.7
Average				53.3	44.8	16.4
8KSTL187		Surface		55.2	48.2	14.3
8KSTL188	K	L	10	54.7	49.1	15.7
8KSTL189				55.1	48.3	15.7
Average				55.0	48.5	15.2
8AMTL87		Mid-		53.2	45.2	17.8
8AMTL88	A	Thick	10	54.6	45.4	15.7
8AMTL89		L		53.2	46.2	16.4
Average				53.7	45.6	16.6
8KMTL142		Mid-		53.9	45.4	19.3
8KMTL143	K	Thick	10	54.3	46.1	17.1
8KMTL144		L		54.1	44.9	17.9
Average				54.1	45.5	18.1
8ASTT133		Surface		53.9	44.3	11.4
8ASTT134	A	LT	10	53.5	45.2	13.6
8ASTT135				53.3	44.8	12.1
Average				53.6	44.8	12.4
8KSTT241		Surface		54.7	48.5	16.4
8KSTT242	K	LT	10	54.8	48.7	15.7
8KSTT243				54.2	46.4	11.4
Average				54.6	47.9	14.5
8ASTL88		Surface		54.0	43.7	18.6
8ASTL89	A	L	100	53.5	45.7	16.4
8ASTL90				53.8	45.2	15.0
Average				53.8	44.9	16.7
8KSTL196		Surface		55.2	47.9	14.3
8KSTL197	K	L	100	54.8	48.1	16.4
8KSTL198				54.7	48.4	19.3
Average				54.9	48.1	16.7
8AMTL105		Mid-		53.1	46.8	15.7
8AMTL106	A	Thick	100	53.7	47.3	15.7
8AMTL107		L		53.6	47.4	15.7
Average				53.5	47.2	15.7

Table XLI - Continued

Specimen	Supplier	Billet Location	Exposure Time (hr)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
8KMTL160		Mid-		53.9	45.8	17.9
8KMTL161	K	Thick	100	55.1	46.8	16.4
8KMTL162		L		55.2	45.5	16.4
Average				54.7	46.0	16.9
8ASTT142		Surface		53.8	44.4	12.1
8ASTT143	A	LT	100	53.8	45.7	10.7
8ASTT144				54.0	44.6	8.6
Average				53.9	44.9	10.5
8KSTT250		Surface		54.2	48.1	12.6
8KSTT251	K	LT	100	54.5	48.7	8.6
8KSTT252				55.0	47.8	9.3
Average				54.6	48.2	10.2
8ASTL97		Surface		52.6	47.5	12.9
8ASTL98	A	L	1000	50.8	47.2	15.0
8ASTL99				50.9	46.4	15.7
Average				51.4	47.0	14.5
8KSTL205		Surface		56.3	51.9	12.9
8KSTL206	K	L	1000	54.7	49.9	10.0
8KSTL207				55.0	50.9	10.0
Average				55.3	50.9	11.0
8KMTL306		Mid-		48.2	43.5	16.4
8KMTL307	K (1)	Thick	1000	49.3	44.5	15.7
8KMTL308		L		48.7	44.3	16.4
Average				48.7	44.1	16.1
8KMTL309		Mid-		47.9	43.2	16.4
8KMTL310	K (1)	Thick	1000	48.9	43.9	16.4
8KMTL311		L		49.0	44.7	16.2
Average				48.6	43.9	16.3
8ASTT151		Surface		50.3	46.8	11.4
8ASTT152	A	LT	1000	51.1	46.1	9.3
8ASTT153				51.6	47.9	9.3
Average				51.0	46.9	10.0
8KSTT259		Surface		54.8	50.7	12.9
8KSTT260	K	LT	1000	55.9	51.8	10.7
8KSTT261				55.5	51.3	8.6
Average				55.4	51.3	10.8

(1) Specimens removed from Billet (d), all other specimens from Billet (b).

Table XLII

THERMAL STABILITY OF 2618 ALUMINUM ALLOY EXPOSED AT 400°F FOR 10, 100 AND 1000 HOURS AND TESTED AT 400°F, SURFACE AND MID-THICKNESS MATERIAL FROM 4" x 8" BILLET LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billets (b) and (d) (2)

Specimen	Supplier	Billet Location	Exposure Time (Hrs)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation %
8ASTL82		Surface	10	45.0	40.8	17.9
8ASTL83	A	L		45.0	40.0	20.0
8ASTL84				45.9	41.2	17.1
Average				45.3	40.7	18.3
8KSTL190		Surface		45.5	43.3	13.6
8KSTL191	K	L	10	44.9	43.0	16.4
8KSTL192				45.0	43.0	21.4
Average				45.1	43.1	17.1
8AMTL90		Mid-		43.4	38.8	18.6
8AMTL91	A	Thick	10	44.4	38.4	13.6
8AMTL92		L		43.5	38.4	15.0
Average				44.1	38.5	15.7
8KMTL145		Mid-		45.1	40.4	12.1
8KMTL146	K	Thick	10	46.2	40.9	14.3
8KMTL147		L		46.6	42.0	12.1
Average				46.0	41.1	12.8
8ASTT136		Surface		44.5	40.4	12.9
8ASTT137	A	LT	10	44.7	39.6	18.6
8ASTT138				45.1	40.9	14.3
Average				44.8	40.3	15.3
8KSTT244		Surface		43.7	41.8	17.9
8KSTT245	K	LT	10	44.2	42.2	18.6
8KSTT246				44.1	42.6	16.4
Average				44.0	42.2	17.6
8ASTL91		Surface		46.5	41.2	10.0
8ASTL92	A	L	100	41.0	36.5	15.7
8ASTL93				41.4	36.9	17.9
Average				43.0	38.2	14.5
8KSTL199		Surface		46.3	42.9	16.4
8KSTL200	K	L	100	44.5	44.0	20.0
8KSTL201				47.0	44.6	14.3
Average				45.9	43.8	16.9
8AMTL108		Mid-		41.6	36.7	16.4
8AMTL109	A	Thick	100	41.4	36.9	15.0
8AMTL110		L		42.1	37.3	15.0
Average				41.7	37.0	15.5

Table XLII - Continued

Specimen	Supplier	Billet Location	Exposure Time (Hrs)	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (%)
8KMTL163		Mid-		41.8	37.0	14.3
8KMTL164	K	Thick	100	41.5	36.6	15.0
8KMTL165		L		41.6	36.9	15.7
Average				41.5	36.7	15.3
8ASTT145		Surface		41.0	35.8	14.3
8ASTT146	A	LT	100	42.5	38.2	11.4
8ASTT147				41.2	37.7	15.0
Average				41.6	37.2	13.6
8KSTT253		Surface		45.5	43.0	12.2
8KSTT254	K	LT	100	45.8	43.1	13.6
8KSTT255				44.9	42.2	11.4
Average				45.4	42.8	12.4
8ASTL100		Surface		39.5	35.2	17.9
8ASTL101	A	L	1000	38.7	34.9	15.7
8ASTL102				37.6	34.8	16.4
Average				38.6	35.0	16.7
8KSTL208		Surface		43.2	38.4	12.9
8KSTL209	K	L	1000	43.4	37.2	17.9
8KSTL210				44.2	38.2	15.7
Average				43.6	37.9	15.5
8KMTL312		Mid-		34.7	30.2	25.0
8KMTL313	K (2)	Thick	1000	34.5	29.6	24.3
8KMTL314		L		34.8	29.5	27.1
Average				34.7	29.8	25.5
8KMTL315		Mid-		(3)	(3)	(3)
8KMTL316	K (2)	Thick	1000	34.2	29.2	22.9
8KMTL317		L		35.4	30.5	22.1
Average				34.8	29.8	22.5
8ASTT154		Surface		39.4	35.2	20.0
8ASTT155	A	LT	1000	39.9	36.5	22.1
8ASTT156				43.0	(1)	18.6
Average				40.8	35.8	20.2
8KSTT262		Surface		43.5	38.2	15.0
8KSTT263	K	LT	1000	42.9	38.0	18.6
8KSTT264				43.1	38.1	18.6
Average				43.2	38.1	17.4

(1) Extensometer Malfunction.
(2) Specimens removed from Billet (d); all other specimens from Billet (b).
(3) Damaged Specimen.

Table XLIII

THERMAL STABILITY OF 2618 ALUMINUM ALLOY EXPOSED AT 325°F AND 400°F FOR 100 AND 1000 HOURS, SURFACE MATERIAL FROM 8" x 11" BILLET, LONGITUDINAL DIRECTION
Billet (c)

Specimen	Supplier	Exposure Temp.(°F)	Exposure Time (Hr)	Test Temp(°F)	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation (%)
11ASTL1					62.0	53.5	9.4
11ASTL2	A	325	100	RT	62.1	53.8	8.8
11ASTL3					61.7	53.4	10.1
Average					61.9	53.6	9.4
11KSTL25					61.1	53.3	6.2
11KSTL26	K	325	100	RT	63.5	55.3	8.8
11KSTL27					63.6	55.1	9.2
Average					62.7	54.9	8.1
11ASTL7					53.4	43.1	10.7
11ASTL8	A	325	1000	RT	53.5	43.3	10.7
11ASTL9					51.0	40.8	11.4
Average					52.6	42.4	10.9
11KSTL31					55.1	44.2	10.7
11KSTL32	K	325	1000	RT	55.2	44.7	10.0
11KSTL33					53.0	42.7	10.0
Average					54.4	43.9	10.2
11ASTL4					53.2	48.2	12.9
11ASTL5	A	325	100	325	53.0	47.9	12.0
11ASTL6					52.9	47.5	11.8
Average					53.0	47.9	12.2
11KSTL28					54.5	49.2	12.1
11KSTL29	K	325	100	325	53.8	47.6	11.4
11KSTL30					54.5	49.2	11.4
Average					54.3	48.7	11.6
11ASTL10					43.7	36.6	16.4
11ASTL11	A	325	1000	325	44.7	38.5	16.4
11ASTL12					45.3	38.9	15.0
Average					44.9	38.0	15.9
11KSTL34					45.7	38.3	14.3
11KSTL35	K	325	1000	325	45.9	39.1	14.3
11KSTL36					45.8	39.2	14.3
Average					45.8	38.9	14.3

Table XLIII-(Continued)

Specimen	Supplier	Exposure Temp.(°F)	Exposure Time (Hr)	Test Temp(°F)	Ultimate Strength (Ksi)	Yield Strength (Ksi)	Elongation (%)
11ASTL13					51.5	41.3	11.2
11ASTL14	A	400	100	RT	53.2	42.6	10.4
11ASTL15					54.4	43.7	10.4
Average					53.0	42.5	10.7
11KSTL37					53.9	43.4	9.0
11KSTL38	K	400	100	RT	55.9	43.5	9.3
11KSTL39					56.8	46.6	8.8
Average					55.5	44.5	9.0
11ASTL19					49.2	37.7	10.7
11ASTL20	A	400	1000	RT	50.5	38.2	10.7
11ASTL21					50.2	37.8	10.7
Average					50.0	37.9	10.7
11KSTL43					52.8	40.4	10.7
11KSTL44	K	400	1000	RT	52.8	40.5	10.0
11KSTL45					51.0	38.4	10.0
Average					52.2	39.8	10.2
11ASTL16					42.2	36.4	16.4
11ASTL17	A	400	100	400	39.6	34.5	15.0
11ASTL18					40.3	34.8	17.9
Average					40.7	35.2	16.4
11KSTL40					42.5	37.3	15.7
11KSTL41	K	400	100	400	41.3	36.1	12.9
11KSTL42					41.9	36.6	15.7
Average					41.9	36.7	14.8
11ASTL22					37.1	31.0	19.3
11ASTL23	A	400	1000	400	37.4	32.2	20.0
11ASTL24					38.2	31.7	21.4
Average					37.6	31.6	20.2
11KSTL46					39.0	32.5	19.3
11KSTL47	K	400	1000	400	39.0	32.6	19.3
11KSTL48					38.8	33.1	19.3
Average					38.9	32.7	19.3

Table XLIV

COMPRESSION PROPERTIES OF 2618 ALUMINUM ALLOY
AT ROOM TEMPERATURE FROM SURFACE MATERIAL OF
3" X 6-1/2" BILLET, LONGITUDINAL, LONG TRANSVERSE
AND SHORT TRANSVERSE DIRECTIONS

Billet (a)

Specimen	Supplier	Billet Location	Yield Strength (KSI)	Modulus X 10^6 (PSI)
6ASPL70		Surface	59.7	11.0
6ASPL71	A	L	60.0	10.0
6ASPL72			57.0	10.6
Average			58.9	10.5
6KSPL70		Surface	56.8	10.3
6KSPL71	K	L	56.2	9.9
6KSPL72			56.1	10.6
Average			56.4	10.3
6ASPT73		Surface	57.3	10.5
6ASPT74	A	LT	57.4	11.0
6ASPT75			57.9	9.7
Average			57.5	10.4
6KSPT73		Surface	55.0	10.2
6KSPT74	K	LT	54.6	10.3
6KSPT75			54.5	9.5
Average			54.7	10.0
6ASPS76		Surface	53.2	11.0
6ASPS77	A	ST	52.1	10.7
6ASPS78			52.8	10.8
Average			52.7	10.8
6KSPS76		Surface	56.2	10.5
6KSPS77	K	ST	56.0	10.5
6KSPS78			59.2	10.1
Average			57.1	10.4

TABLE XLV

COMPRESSION PROPERTIES OF 2618 ALUMINUM ALLOY AT
ROOM TEMPERATURE, 250°F, 325°F AND 400°F FROM
SURFACE, QUARTER-THICKNESS AND MID-THICKNESS
OF 4" x 8" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billet (b)

Specimen	Supplier	Billet Location	Test Temp (°F)	Yield Strength (KSI)	Modulus PSI x 10^6
8ASPL1		Surface		54.0	10.1
8ASPL2	A	L	RT	53.9	10.6
8ASPL3				55.0	10.8
Average				54.3	10.5
8KSPL37		Surface		55.2	10.5
8KSPL38	K	L	RT	55.8	10.8
8KSPL39				54.5	10.4
Average				55.2	10.6
8AQPL1		Quarter-		53.3	10.2
8AQPL2	A	Thick	RT	53.4	10.2
8AQPL3		L		52.1	10.3
Average				52.9	10.2
8KQPL4		Quarter-		55.7	10.7
8KQPL5	K	Thick	RT	54.5	10.7
8KQPL6		L		55.4	10.9
Average				55.2	10.8
8AMPL1		Mid-		49.5	10.5
8AMPL2	A	Thick	RT	49.9	9.9
8AMPL3		L		52.1	10.1
Average				50.5	10.2
8KMPL4		Mid-		51.5	10.4
8KMPL5	K	Thick	RT	50.1	9.7
8KMPL6		L		53.8	10.5
Average				51.8	10.2
8ASPT13		Surface		50.2	10.4
8ASPT14	A	LT	RT	51.3	10.4
8ASPT15				51.9	10.5
Average				51.1	10.4
8KSPT49		Surface		54.9	10.3
8KSPT50	K	LT	RT	54.9	10.3
8KSPT51				54.4	11.0
Average				54.7	10.5
8ASPL4		Surface		52.7	10.3
8ASPL5	A	L	250	52.7	10.5
8ASPL6				52.2	10.6
Average				52.5	10.5

TABLE XLV (continued)

Specimen	Supplier	Billet Location	Test Temp (°F)	Yield Strength (KSI)	Modulus PSI x 10^6
8KSPL40		Surface		55.5	10.7
8KSPL41	K	L	250	54.7	10.1
8KSPL42				54.8	10.4
Average				55.0	10.4
8ASPT16		Surface		54.4	10.1
8ASPT17	A	LT	250	48.2	9.2
8ASPT18				52.2	9.8
Average				51.6	9.7
8ASPL7		Surface		49.8	9.4
8ASPL8	A	L	325	49.8	9.6
8ASPL9				51.0	9.8
Average				50.2	9.5
8KSPL43		Surface		52.3	9.5
8KSPL44	K	L	325	52.5	9.7
8KSPL45				52.6	9.7
Average				52.5	9.6
8ASPT19		Surface		49.7	10.0
8ASPT20	A	LT	325	49.1	9.9
8ASPT21				(1)	(1)
Average				49.4	10.0
8ASPL10		Surface		46.8	9.9
8ASPL11	A	L	400	45.9	9.5
8ASPL12				48.3	10.3
Average				47.0	9.9
8KSPL46		Surface		44.7	9.4
8KSPL47	K	L	400	47.2	9.4
8KSPL48				47.8	9.3
Average				46.6	9.4
8ASPT22		Surface		44.7	9.6
8ASPT23	A	LT	400	44.6	9.5
8ASPT24				44.7	9.5
Average				44.6	9.5

(1) Compressometer malfunction

Table XLVI

COMPRESSION PROPERTIES OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE OF 8" X 11" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS

Billet (c)

Specimen	Supplier	Billet Location	Test Temp.(°F)	Yield Strength (Ksi)	Modulus X 10^6 (Psi)
11ASPL1		Surface		52.0	11.2
11ASPL2	A	L	RT	54.1	10.3
11ASPL3				52.1	10.2
Average				52.7	10.6
11KSPL10		Surface		54.9	11.1
11KSPL11	K	L	RT	54.4	11.3
11KSPL12				55.3	11.3
Average				54.9	11.2
11ASPT4		Surface		50.0	10.6
11ASPT5	A	LT	RT	49.0	10.7
11ASPT6				48.9	10.5
Average				49.3	10.6
11KSPT14		Surface		53.5	10.3
11KSPT15	K	LT	RT	53.2	10.3
11KSPT16				52.4	10.4
Average				53.0	10.3
11ASPS7		Surface		48.7	10.3
11ASPS8	A	ST	RT	48.7	11.2
11ASPS9				50.6	11.6
Average				49.3	11.0
11KSPS17		Surface		55.8	11.4
11KSPS18	K	ST	RT	55.9	11.0
11KSPS19				53.8	11.0
Average				55.2	11.1

Table XLVII

COMPRESSION PROPERTIES OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE, 250°F, 325°F, AND 400°F, FROM SURFACE QUARTER-THICKNESS AND MID-THICKNESS OF 4" X 8" KAISER BILLET LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS

Billet (d)

Specimen	Billet Location	Test Temperature °F	Yield Strength (Ksi)	Modulus X10^6 Psi
8KSPL300	Surface		52.1	10.5
8KSPL301	L	RT	52.6	10.3
8KSPL302			52.4	10.6
Average			52.4	10.4
8KSPT303	Surface		49.1	10.2
8KSPT304	LT	RT	50.9	10.3
8KSPT305			49.8	11.8
Average			49.9	10.7
8KSPS315			51.0	11.3
8KSPS316			51.0	7.6 (1)
8KSPS317	Surface		51.1	10.6
8KSPS318	ST	RT	51.1	10.7
8KSPS319			50.6	10.5
8KSPS320			51.8	10.4
Average			51.1	10.7
8KQPL339	Quarter		53.7	10.4
8KQPL340	Thick	RT	54.1	10.6
8KQPL341	L		53.3	10.4
Average			53.7	10.4
8KMPL342	Mid-		53.7	10.8
8KMPL343	Thick	RT	53.5	10.6
8KMPL344	L		53.4	10.4
Average			53.5	10.6
8KSPT306	Surface		49.5	10.2
8KSPT307	LT	250	49.5	10.2
8KSPT308			49.6	9.7
Average			49.5	10.0
8KSPS321			50.4	10.0
8KSPS322			50.6	9.6
8KSPS323	Surface		50.4	9.6
8KSPS324	ST	250	50.8	9.8
8KSPS325			50.9	10.4
8KSPS326			49.7	10.1
Average			50.4	9.9

Table XLVII - Continued

Specimen	Billet Location	Test Temperature °F	Yield Strength (Ksi)	Modulus X10^6 Psi
8KSPT309	Surface		(2)	(2)
8KSPT310	LT	325	48.3	9.8
8KSPT311			48.7	10.1
Average			48.5	9.9
8KSPS327			48.5	9.5
8KSPS328			47.8	9.5
8KSPS329	Surface	325	47.2	9.8
8KSPS330	ST		48.7	9.7
8KSPS331			47.8	9.9
8KSPS332			48.8	9.8
Average			48.1	9.7
8KSPT312	Surface		44.6	9.1
8KSPT313	LT	400	44.4	9.7
8KSPT314			43.9	9.7
Average			44.3	9.5
8KSPS333			43.7	9.3
8KSPS334			44.3	9.1
8KSPS335	Surface		45.2	9.2
8KSPS336	ST	400	45.4	9.4
8KSPS337			43.9	9.2
8KSPS338			44.4	9.3
Average			44.4	9.2

(1) Compressometer error, not included in average.

(2) Compressometer malfunction.

Table XLVIII

BEARING PROPERTIES, e/D=2.0, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE, 325°F AND 400°F FROM SURFACE MATERIAL OF 3" x 6-1/2" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTION

Billet (a)

Specimen	Supplier	Billet Location	Test Temperature (°F)	Ultimate Strength (KSI)	Yield Strength (KSI)
6ASBL25		Surface		125.3	(1)
6ASBL26	A	L	RT	119.3	95.2
6ASBL27				122.6	95.2
Average				122.4	95.2
6KSBL25		Surface		117.9	89.7
6KSBL26	K	L	RT	119.9	84.4
6KSBL27				116.5	84.3
Average				118.1	86.1
6ASBT34		Surface		122.0	90.3
6ASBT35	A	LT	RT	122.6	89.5
6ASBT36				125.3	89.5
Average				123.3	89.8
6KSBT34		Surface		127.1	89.8
6KSBT35	K	LT	RT	124.4	91.6
6KSBT36				122.1	91.2
Average				124.5	90.9
6ASBL28		Surface		112.2	80.8
6ASBL29	A	L	325	116.6	79.4
6ASBL30				114.0	83.1
Average				114.3	81.1
6KSBL28		Surface		112.3	81.4
6KSBL29	K	L	325	113.5	75.6
6KSBL30				114.2	79.9
Average				113.3	79.0
6ASBT37		Surface		117.9	80.3
6ASBT38	A	LT	325	117.0	82.6
6ASBT39				116.0	(1)
Average				117.0	81.5
6KSBT37		Surface		110.2	76.7
6KSBT38	K	LT	325	112.4	77.3
6KSBT39				113.1	78.4
Average				111.9	77.5

Table XLVIII - Continued

Specimen	Supplier	Billet Location	Test Temperature (°F)	Ultimate Strength (KSI)	Yield Strength (KSI)
6ASBL31		Surface		98.2	65.0
6ASBL32	A	L	400	99.9	70.3
6ASBL33				99.6	70.7
Average				99.2	68.7
6KSBL31		Surface		98.6	73.2
6KSBL32	K	L	400	99.9	72.4
6KSBL33				99.6	69.7
Average				99.4	71.8
6ASBT40		Surface		96.7	72.4
6ASBT41	A	LT	400	101.5	70.1
6ASBT42				98.5	70.6
Average				98.9	71.0
6KSBT40		Surface		104.0	67.8
6KSBT41	K	LT	400	103.3	70.2
6KSBT42				101.8	70.7
Average				103.0	69.6

(1) Extensometer malfunction.

Table XLIX

BEARING PROPERTIES, e/D=2.0, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE, 250°F, 325°F, and 400°F FROM SURFACE QUARTER-THICKNESS AND MID-THICKNESS OF 4" x 8" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTION

Billet (b)

Specimen	Supplier	Billet Location	Test Temperature (°F)	Ultimate Strength (KSI)	Yield Strength (KSI)
8ASBL1		Surface		127.4	88.8
8ASBL2	A	L	RT	120.9	85.5
8ASBL3				117.1	88.3
Average				121.8	87.5
8KSBL25		Surface		124.1	93.3
8KSBL26	K	L	RT	124.5	91.6
8KSBL27				120.3	87.7
Average				123.0	90.9
8AQBL1		Quarter		125.6	90.3
8AQBL2	A	Thick	RT	125.6	91.8
8AQBL3		L		123.6	92.3
Average				124.9	91.4
8KQBL4		Quarter		130.3	95.4
8KQBL5	K	Thick	RT	131.2	96.0
8KQBL6		L		125.6	94.9
Average				129.0	95.4
8AMBL1		Mid		125.6	91.2
8AMBL2	A	Thick	RT	128.4	94.6
8AMBL3		L		123.9	93.2
Average				126.0	93.0
8AMBL4		Mid		132.1	95.1
8AMBL5	K	Thick	RT	131.8	95.5
8AMBL6		L		128.6	92.0
Average				130.8	94.2
8ASBT13		Surface		122.7	88.3
8ASBT14	A	LT	RT	123.9	86.9
8ASBT15				127.5	92.3
Average				124.7	89.2
8KSBT37		Surface		124.7	96.4
8KSBT38	K	LT	RT	122.8	95.0
8KSBT39				126.5	94.6
Average				124.7	95.3
8ASBL4		Surface		121.2	86.5
8ASBL5	A	L	250	120.3	84.2
8ASBL6				118.5	83.8
Average				120.0	84.8
8KSBL28		Surface		123.1	80.7
8KSBL29	K	L	250	122.0	81.4
8KSBL30				124.2	81.8
Average				123.1	81.3

Table XLIX - Continued

Specimen	Supplier	Billet Location	Test Temperature (°F)	Ultimate Strength (KSI)	Yield Strength (KSI)
8ASBT16		Surface		117.1	80.2
8ASBT17	A	LT	250	119.8	79.7
8ASBT18				120.3	82.0
Average				119.1	80.6
8KSBT40		Surface		123.0	81.4
8KSBT41	K	LT	250	120.8	82.2
8KSBT42				124.3	81.3
Average				122.7	81.6
8ASBL7		Surface		113.1	79.9
8ASBL8	A	L	325	111.3	83.3
8ASBL9				116.0	78.8
Average				113.5	80.7
8KSBL31		Surface		114.6	76.6
8KSBL32	K	L	325	112.1	82.0
8KSBL33				106.9	81.4
Average				111.2	80.0
8ASBT19		Surface		113.6	77.3
8ASBT20	A	LT	325	116.0	82.0
8ASBT21				115.3	80.2
Average				115.0	79.5
8KSBT43		Surface		115.0	79.4
8KSBT44	K	LT	325	111.0	78.0
8KSBT45				113.6	81.1
Average				113.2	79.5
8ASBL10		Surface		102.0	69.8
8ASBL11	A	L	400	103.6	70.3
8ASBL12				104.1	72.5
Average				103.2	70.9
8KSBL34		Surface		104.4	71.3
8KSBL35	K	L	400	102.2	69.5
8KSBL36				101.3	68.6
Average				102.6	69.8
8ASBT22		Surface		105.9	70.7
8ASBT23	A	LT	400	103.6	69.8
8ASBT24				106.3	69.8
Average				105.3	70.1
8KSBT46		Surface		103.8	73.9
8KSBT47	K	LT	400	100.2	71.9
8KSBT48				103.0	70.0
Average				102.3	71.9

Table L

BEARING PROPERTIES, e/D = 2.0, OF 2618 ALUMINUM ALLOY
AT ROOM TEMPERATURE FROM SURFACE OF 8" x 11" BILLET
LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billet (c)

Specimen	Supplier	Billet Location	Yield Strength (KSI)	Ultimate Strength (KSI)
11ASBL1		Surface	90.2	120.9
11ASBL2	A	L	95.3	128.2
11ASBL3			92.8	126.6
Average			92.8	125.2
11KSBL7		Surface	92.3	125.6
11KSBL8	K	L	91.5	123.5
11KSBL9			96.2	127.8
Average			93.3	125.6
11ASBT4		Surface	92.7	126.5
11ASBT5	A	LT	92.7	123.9
11ASBT6			87.2	125.2
Average			90.9	125.2
11KSBT10		Surface	92.8	134.7
11KSBT11	K	LT	95.3	129.5
11KSBT12			97.0	129.1
Average			95.0	131.1

Table LI

BEARING PROPERTIES, e/D=2.0, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE, QUARTER-THICKNESS, AND MID-THICKNESS OF 4" x 8" KAISER BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billet (d)

Specimen	Billet Location	Ultimate Strength (KSI)	Yield Strength (KSI)
8KSBL300	Surface	118.0	89.2
8KSBL301	L	118.5	84.2
8KSBL302		120.5	83.8
Average		119.0	85.7
8KSBT303	Surface	118.9	84.7
8KSBT304	LT	125.0	84.5
8KSBT305		124.8	86.5
Average		122.9	85.2
8KQBL306	Quarter	121.1	85.8
8KQBL307	Thick	121.8	86.7
8KQBL308	L	125.3	85.8
Average		122.7	86.1
8KMBL309	Mid	122.5	86.3
8KMBL310	Thick	122.7	80.9
8KMBL311	L	124.0	87.1
Average		123.1	84.8

Table LII

SHEAR PROPERTIES OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE MATERIAL OF 3" X 6-1/2" BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTION
Billet (a)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)
6ASSL43		Surface	45.0
6ASSL44	A	L	44.8
6ASSL45			44.3
Average			44.7
6KSSL43		Surface	43.6
6KSSL44	K	L	42.4
6KSSL45			42.1
Average			42.7
6ASST46		Surface	42.6
6ASST47	A	LT	42.8
6ASST48			42.7
Average			42.7
6KSST46		Surface	42.4
6KSST47	K	LT	42.3
6KSST48			42.4
Average			42.4
6ASSS49		Surface	41.0
6ASSS50	A	ST	40.3
6ASSS51			41.0
Average			40.8
6KSSS49		Surface	41.2
6KSSS50	K	ST	40.6
6KSSS51			41.2
Average			41.0

Table LIII

**SHEAR PROPERTIES OF 2618 ALUMINUM ALLOY
AT ROOM TEMPERATURE, 250°F, 325°F AND 400°F FROM SURFACE,
QUARTER-THICKNESS AND MID-THICKNESS OF 4" X 8" BILLET,
LONGITUDINAL LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS**

Billet (8)

Specimen	Supplier	Billet Location	Test Temp. (°F)	Ultimate Strength (Ksi)
8ASSL1		Surface		42.4
8ASSL2	A	L	RT	40.8
8ASSL3				41.0
Average				41.4
8KSSL37		Surface		40.9
8KSSL38	K	L	RT	41.3
8KSSL39				41.4
Average				41.2
8AQSL1		Quarter		44.0
8AQSL2	A	Thick	RT	43.9
8AQSL3		L		43.6
Average				43.8
8KQSL4		Quarter		43.9
8KQSL5	K	Thick	RT	43.4
8KQSL6		L		43.8
Average				43.7
8AMSL1		Mid-		47.9
8AMSL2	A	Thick	RT	50.0
8AMSL3		L		47.6
Average				48.5
8KMSL4		Mid-		44.0
8KMSL5	K	Thick	RT	45.4
8KMSL6		L		46.4
Average				45.2
8ASST13		Surface		40.7
8ASST14	A	LT	RT	42.0
8ASST15				43.0
Average				41.9
8KSST49		Surface		42.3
8KSST50	K	LT	RT	43.3
8KSST51				44.2
Average				43.3
8ASSS25		Surface		40.2
8ASSS26	A	ST	RT	39.5
8ASSS27				38.2
Average				39.3

Table LIII (Continued)

Specimen	Supplier	Billet Location	Test Temp. (°F)	Ultimate Strength (Ksi)
8KSSS61		Surface		42.9
8KSSS62	K	ST	RT	43.0
8KSSS63				42.6
Average				42.8
8ASSL4		Surface		40.1
8ASSL5	A	L	250	40.8
8ASSL6				40.2
Average				40.4
8KSSL40		Surface		38.4
8KSSL41	K	L	250	39.4
8KSSL42				39.6
Average				39.1
8ASST16		Surface		42.5
8ASST17	A	LT	250	42.2
8ASST18				41.5
Average				42.1
8KSST52		Surface		43.2
8KSST53	K	LT	250	44.4
8KSST54				39.8
Average				42.5
8ASSS28		Surface		36.8
8ASSS29	A	ST	250	36.4
8ASSS30				39.0
Average				37.4
8KSSS64		Surface		39.5
8KSSS65	K	ST	250	39.1
8KSSS66				39.1
Average				39.2
8ASSL7		Surface		37.4
8ASSL8	A	L	325	36.8
8ASSL9				38.1
Average				37.4
8KSSL43		Surface		36.2
8KSSL44	K	L	325	36.9
8KSSL45				36.3
Average				36.4
8ASST19		Surface		39.5
8ASST20	A	LT	325	38.3
8ASST21				39.0
Average				38.9

Table LIII (Continued)

Specimen	Supplier	Billet Location	Test Temp.(°F)	Ultimate Strength (Ksi)
8KSST55		Surface		(1)
8KSST56	K	LT	325	39.7
8KSST57				41.2
Average				40.5
8ASSS31		Surface		38.7
8ASSS32	A	ST	325	38.4
8ASSS33				37.5
Average				38.2
8KSSS67		Surface		40.4
8KSSS68	K	ST	325	39.9
8KSSS69				40.7
Average				40.3
8ASSL10		Surface		33.6
8ASSL11	A	L	400	33.6
8ASSL12				32.7
Average				33.3
8KSSL46		Surface		32.4
8KSSL47	K	L	400	32.9
8KSSL48				33.4
Average				32.9
8ASST22		Surface		35.1
8ASST23	A	LT	400	34.7
8ASST24				35.7
Average				35.1
8KSST58		Surface		37.9
8KSST59	K	LT	400	36.6
8KSST60				39.8
Average				38.1
8ASSS34		Surface		32.9
8ASSS35	A	ST	400	33.2
8ASSS36				(1)
Average				33.1
8KSSS70		Surface		34.3
8KSSS71	K	ST	400	33.7
8KSSS72				34.6
Average				34.2

(1) Test equipment malfunction.

Table LIV

SHEAR PROPERTIES OF 2020 ALUMINUM ALLOY
AT ROOM TEMPERATURE FROM SURFACE OF 8" X 11" BILLET,
LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Billet (c)

Specimen	Supplier	Billet Location	Ultimate Strength (Ksi)
11ASSL1		Surface	44.4
11ASSL2	A	L	44.0
11ASSL3			43.8
Average			44.0
11KSSL7		Surface	45.1
11KSSL8	K	L	44.0
11KSSL9			45.4
Average			44.8
11ASST4		Surface	40.9
11ASST5	A	LT	40.6
11ASST6			41.6
Average			41.0
11KSST10		Surface	43.0
11KSST11	K	LT	41.2
11KSST12			40.9
Average			41.7

Table LV

SHEAR PROPERTIES OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE, QUARTER THICKNESS AND MID-THICKNESS OF 4" X 8" KAISER BILLET, LONGITUDINAL, LONG TRANSVERSE AND SHORT TRANSVERSE DIRECTIONS

Billet (d)

Specimen	Billet Location	Ultimate Strength (Ksi)
8KSSL300	Surface	38.3
8KSSL301	L	38.3
8KSSL302		38.2
Average		38.3
8KSST303	Surface	39.8
8KSST304	LT	38.9
8KSST305		39.1
Average		39.2
8KSSS306	Surface	37.5
8KSSS307	ST	39.5
8KSSS308		38.4
Average		38.5
8KQSL309	Quarter	40.0
8KQSL310	Thick	38.7
8KQSL311	L	39.0
Average		39.2
8KMSL312	Mid-	40.0
8KMSL313	Thick	40.6
8KMSL314	L	39.8
Average		40.1

Table LVI

AXIAL LOAD FATIGUE PROPERTIES, R=0.05, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM MID-THICKNESS OF 3" x 6-1/2" BILLET LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Unnotched Specimens, Billet (a)

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT1	Alcoa Mid-Thickness Longitudinal	60	4,600	
AT2		60	5,400	
AT3		60	100	
AT11		55	18,300	
AT4		50	12,700	
AT5		50	13,700	
AT6		50	53,600	
AT12		45	116,200	
AT7		40	157,300	
AT8		40	1,492,200	
AT9		40	1,379,800	
AT10		37	10,160,000	No Failure
AT28	Alcoa Mid-Thickness Long Transverse	55	2,200	
AT25		50	50,300	
AT33		50	56,600	
AT34		50	16,100	
AT29		45	125,500	
AT30		45	43,000	
AT32		45	93,500	
AT26		40	54,600	
AT27		40	343,500	
AT31		40	120,900	
AT35		37	75,800	
AT36		35	791,800	
AT49	Kaiser Mid-Thickness Longitudinal	55	9,500	
AT50		55	12,100	
AT51		55	1,600	
AT55		50	36,000	
AT56		50	12,400	
AT57		50	18,800	
AT58		45	72,200	
AT60		45	109,200	
AT52		40	433,400	
AT53		40	1,926,000	
AT54		40	1,716,100	
AT59		38	585,800	

Table LVI - Continued

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT76		55	500	
AT73		50	10,700	
AT77		50	6,600	
AT82	Kaiser	50	17,200	
AT78	Mid-Thickness	45	27,400	
AT79	Long Transverse	45	20,000	
AT81		45	56,800	
AT74		40	367,400	
AT75		40	124,400	
AT80		40	137,900	
AT83		37	486,400	
AT84		35	15,160,600	No Failure

Table LVII

AXIAL LOAD FATIGUE PROPERTIES, R=0.05,
OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE
FROM MID-THICKNESS OF 4" x 8" BILLET,
LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS
Unnotched Specimens
Billet (b)

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT276		60	100	
AT294		60	1,700	
AT277		55	8,300	
AT282		55	4,200	
AT283	Alcoa	55	1,100	
AT284	Mid-Thickness	55	3,200	
AT285	Longitudinal	55	-	Failed on Loading
AT275		50	11,100	
AT296		50	10,100	
AT278		45	126,400	
AT279		45	104,000	
AT286		45	284,600	
AT287		45	135,100	
AT288		45	253,100	
AT289		45	108,600	
AT272		40	152,300	
AT295		40	9,401,300	
AT280		35	5,501,800	
AT290		35	229,700	
AT291		35	10,000,000	No Failure
AT292		35	13,349,000	No Failure
AT293		35	10,194,000	No Failure
AT273		30	16,379,700	No Failure
AT322		60	2,900	
AT328		60	1,200	
AT329		60	1,900	
AT330		60	300	
AT331		60	1,200	
AT323		55	6,500	
AT341	Alcoa	55	100	
AT343	Mid-Thickness	55	600	
AT344	Long Transverse	55	200	
AT345		55	300	
AT324		50	48,600	

Table LVII - Continued

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT332	Alcoa	50	16,500	
AT333	Mid-Thickness	50	18,900	
AT334	Long Transverse	50	28,000	
AT335	(Continued)	50	10,900	
AT336		50	12,500	
AT325		45	137,800	
AT346		45	107,500	
AT326		40	2,606,700	
AT337		40	8,067,100	
AT338		40	336,600	
AT339		40	2,252,700	
AT340		40	5,604,800	
AT327		35	10,384,400	No Failure
AT375		55	27,000	
AT376		55	3,500	
AT378		55	4,200	
AT372	Kaiser	50	30,600	
AT373	Mid-Thickness	50	61,300	
AT379	Longitudinal	50	13,000	
AT381		45	824,400	
AT382		45	697,200	
AT383		45	1,946,700	
AT374		40	1,684,100	
AT377		40	907,100	
AT380		40	548,500	
AT351		50	2,900	
AT352	Kaiser	50	4,700	
AT355	Mid-Thickness	50	5,300	
AT353	Long Transverse	45	211,600	
AT354		45	56,400	
AT356		45	138,000	
AT347		40	213,600	
AT348		40	211,500	
AT350		40	132,200	
AT346		38	447,400	
AT357		37	530,700	

TABLE LVIII

AXIAL LOAD FATIGUE PROPERTIES, R = 0.05, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE AND MID-THICKNESS OF 8" x 11" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Unnotched Specimens
Billet (c)

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT382		50	62,900	
AT385		50	7,600	
AT391		50	42,200	
AT384	Alcoa	45	113,000	
AT387	Surface	45	13,000	
AT388	Longitudinal	45	19,000	
AT383		40	191,700	
AT386		40	194,400	
AT389		40	374,800	
AT390		40	983,000	
AT392		37	539,300	
AT393		35	108,800	
AT436		50	40,300	
AT437		50	6,800	
AT441	Alcoa	50	6,600	
AT438	Mid-Thickness	50	8,100	
AT434	Longitudinal	45	88,800	
AT435		45	115,600	
AT439		45	180,000	
AT432		40	941,400	
AT433		40	660,000	
AT440		40	295,800	
AT430		35	2,302,400	
AT431		33	10,318,000	Did not fail
AT454		50	300	
AT457		45	14,800	
AT461		45	3,200	
AT463	Alcoa	45	28,800	
AT455	Mid-Thickness	40	137,000	
AT456	Long Transverse	40	97,600	
AT464		40	49,400	
AT458		35	123,900	
AT459		35	852,800	
AT465		35	84,200	
AT460		33	115,200	
AT462		33	3,757,100	

Table LVIII - Continued

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT406		50	62,900	
AT409		50	99,000	
AT412		50	12,100	
AT413	Kaiser	50	40,500	
AT407	Surface	45	38,300	
AT410	Longitudinal	45	26,300	
AT416		45	57,800	
AT408		40	-	Bent specimen
AT411		40	601,000	
AT414		40	8,910,800	
AT415		40	177,600	
AT417		40	10,282,500	Did not fail
AT478		50	14,800	
AT480		50	10,100	
AT486		50	25,500	
AT489	Kaiser	50	67,100	
AT479	Mid-Thickness	45	41,200	
AT481	Longitudinal	45	50,000	
AT487		45	369,400	
AT482		40	107,800	
AT483		40	116,600	
AT488		40	4,142,800	
AT484		35	3,238,700	
AT485		33	10,579,700	Did not fail
AT504		55	8,600	
AT505		50	11,200	
AT502	Kaiser	50	31,700	
AT506	Mid-Thickness	45	5,300	
AT508	Long Transverse	45	40,600	
AT510		45	87,200	
AT511		45	54,800	
AT503		40	151,100	
AT507		40	277,200	
AT509		40	426,700	
AT512		35	1,079,100	
AT513		33	10,847,000	Did not fail

Table LIX

AXIAL LOAD FATIGUE PROPERTIES, R = 0.05,
OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE
FROM MID-THICKNESS OF 3" x 6-1/2" BILLET,
LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS

Notched Specimens, K_t = 2.4
Billet (a)

Specimen	Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT17		45	9,700	
AT14		40	22,700	
AT13		40	18,300	
AT18		35	26,000	
AT20		35	25,400	
AT15	Alcoa	30	77,400	
AT16	Mid-Thickness	30	52,900	
AT19	Longitudinal	25	117,400	
AT21		25	100,500	
AT22		20	307,000	
AT23		15	304,800	
AT24		15	432,700	
AT40		45	-	Failed on Loading
AT37		40	13,100	
AT42		40	12,400	
AT46		40	9,600	
AT38	Alcoa	35	17,200	
AT39	Mid-Thickness	30	38,300	
AT43	Long Transverse	30	37,000	
AT41		25	110,400	
AT45		25	73,000	
AT47		25	73,900	
AT44		20	1,054,700	
AT48		18	1,925,000	
AT68		50	6,030	
AT65		45	12,900	
AT61		40	25,700	
AT66		40	25,100	
AT62		30	50,900	
AT67	Kaiser	30	71,900	
AT70	Mid-Thickness	25	40,000	
AT72	Longitudinal	25	67,100	
AT63		20	188,500	
AT69		20	13,155,000	Did not fail
AT71		20	2,560,300	Did not fail
AT64		15	10,183,600	Did not fail

Table LIX - Continued

Specimen	Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT85		40	10,700	
AT89		40	7,600	
AT92		40	14,000	
AT86	Kaiser	35	22,600	
AT87	Mid-Thickness	30	36,100	
AT90	Long Transverse	30	35,400	
AT93		30	59,200	
AT88		25	92,000	
AT91		25	51,500	
AT95		25	106,800	
AT94		20	216,900	
AT96		15	13,430,700	

Table LI

AXIAL LOAD FATIGUE PROPERTIES, R = 0.05 OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM MID-THICKNESS OF 4" x 8" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTION, NOTCHED SPECIMENS, K_t = 2.4

Billet (b)

Specimen	Supplier and Billet Location	Maximum Stress (Ksi)	Cycles To Failure	Remarks
AT 298		50	8,300	
AT 299		50	5,000	
AT 314		45	10,800	
AT 315		45	9,700	
AT 320		45	8,400	
AT 300		40	21,500	
AT 301	Alcoa	40	14,400	
AT 308	Mid-Thickness	40	18,400	
AT 309	Longitudinal	40	14,200	
AT 316		35	27,700	
AT 317		35	29,100	
AT 318		35	28,900	
AT 302		30	93,600	
AT 303		30	79,700	
AT 310		30	71,900	
AT 311		30	45,000	
AT 297		25	420,300	
AT 304		25	134,100	
AT 306		25	207,300	
AT 312		25	395,700	
AT 313		25	138,500	
AT 307		22.5	538,500	
AT 319		22	772,500	
AT 321		21	830,100	
AT 305		20	10,868,900	No Failure
AT 369		50	4,100	
AT 349		45	7,000	
AT 362		45	7,300	
AT 348		40	11,500	
AT 352		40	11,800	
AT 353	Alcoa	40	12,200	
AT 354	Mid-Thickness	40	8,100	
AT 364	Long Transverse	40	13,100	
AT 368		35	22,200	
AT 371		35	21,900	
AT 347		30	45,900	
AT 355		30	35,000	
AT 356		30	48,200	

Table LX (Continued)

Specimen	Supplier and Billet Location	Maximum Stress (Ksi)	Cycles To Failure	Remarks
AT 357		30	54,600	
AT 365		30	43,000	
AT 350	Alcoa	25	166,200	
AT 358	Mid-Thickness	25	190,300	
AT 359	Long Transverse	25	(2)	
AT 360	(Continued)	25	113,200	
AT 363		25	195,000	
AT 366		25	474,100	
AT 361		25	163,900	
AT 351		20	1,088,600	
AT 367		18	829,700	
AT 370		15	10,580,100	No Failure
AT 339		50	5,900	
AT 336		45	9,000	
AT 335		40	17,500	
AT 338	Kaiser	40	17,300	
AT 340	Mid-Thickness	35	30,000	
AT 344	Longitudinal	35	29,200	
AT 334		30	87,500	
AT 341		30	50,900	
AT 337		25	199,400	
AT 342		25	95,600	
AT 343		20	711,700	
AT 345		18	1,050,000	
AT 365		50	(1)	
AT 366		50	3,500	
AT 362	Kaiser	45	6,500	
AT 360	Mid-Thickness	40	11,600	
AT 361	Long Transverse	40	12,900	
AT 358		30	42,000	
AT 359		30	49,400	
AT 363		25	132,300	
AT 364		25	138,900	
AT 369		35	22,[illegible]00	
AT 368		22.5	300,000	
AT 367		20	3,670,000	

(1) Failed on loading.

(2) Bent Specimen.

Table LXI

AXIAL LOAD FATIGUE PROPERTIES, R = 0.05, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE AND MID-THICKNESS OF 8" X 11" BILLET, LONGITUDINAL AND LONG TRANSVERSE DIRECTIONS NOTCHED SPECIMENS, Kt = 2.4

Billet (c)

Specimen	Supplier and Billet Location	Maximum Stress (Ksi)	Cycles To Failure	Remarks
AT-397		50	6,400	
399		"	4,900	
403	Alcoa	45	11,700	
405	Surface	45	18,100	
394	Longitudinal	40	18,100	
400		"	18,600	
396		35	43,600	
402		"	22,700	
395		30	101,400	
401		"	94,900	
398		25	1,589,200	
404		20	1,340,600	
AT-445		45	10,700	
443		40	12,600	
446	Alcoa	"	14,300	
451	Mid-	35	23,300	
444	Thickness	30	46,200	
447	Longitudinal	30	52,200	
448		25	165,100	
449		25	185,400	
442		20	203,200	
450		20	849,900	
452		18	393,100	
453		18	1,113,300	
AT-473		50	4,000	
468		45	5,500	
466		40	12,600	
475	Alcoa	40	13,800	
469	Mid-	35	26,400	
474	Thickness	35	20,100	
467	Long	30	68,900	
476	Transverse	30	47,400	
470		25	95,600	
471		25	176,000	
472		20	281,600	
477		17	11,095,000	No Failure

Table LXI (Continued)

Specimen	Supplier and Billet Location	Maximum Stress (Ksi)	Cycles To Failure	Remarks
AT-419		50	5,000	
421		45	8,600	
418	Kaiser	40	16,000	
426	Surface	40	20,900	
420	Longitudinal	35	36,300	
423		35	31,500	
422		30	96,200	
427		30	76,200	
424		25	138,700	
428		25	242,900	
425		20	311,100	
429		18	13,985,700	No Failure
AT-496		50	5,700	
491		45	9,800	
490	Kaiser	40	13,400	
500	Mid-	40	12,900	
497	Thickness	35	21,000	
501	Longitudinal	35	16,000	
492		30	36,100	
498		30	37,200	
493		25	102,600	
494		20	346,700	
499		20	141,100	
495		18	10,222,100	No Failure
AT-523		50	3,500	
516		45	6,800	
514	Kaiser	40	10,400	
519	Mid-	40	12,200	
518	Thickness	35	20,900	
515	Long	30	63,000	
520	Transverse	30	40,000	
517		25	97,200	
522		25	84,700	
524		22.5	98,900	
525		22	164,400	
521		20	12,133,500	

Table LXII

ROTATING BEAM FATIGUE PROPERTIES, R=-1.0, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE, QUARTER-THICKNESS AND MID-THICKNESS OF 4" x 8" BILLET, LONGITUDINAL DIRECTION
Unnotched Specimens
Billet (b)

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT112		50	18,400	
AT108		60	4,300	
AT106		60	11,400	
AT105		55	6,600	
AT98		50	14,300	
AT109		50	16,100	
AT110		50	16,700	
AT111	Alcoa	50	18,570	
AT104	Surface	45	28,600	
AT102	Longitudinal	40	57,600	
AT113		40	89,250	
AT114		40	71,600	
AT115		40	73,700	
AT116		40	79,900	
AT103		35	168,200	
AT99		30	513,900	
AT117		30	1,341,600	
AT118		30	564,550	
AT119		30	590,050	
AT120		30	613,900	
AT101		25	4,211,600	
AT121		23	10,020,650	No Failure
AT100		20	10,092,100	No Failure
AT265		60	4,450	
AT248		50	13,475	
AT252	Alcoa	50	14,050	
AT253	Quarter-Thickness	50	14,250	
AT254	Longitudinal	50	13,500	
AT255		50	11,300	
AT256		40	62,350	
AT257		40	50,900	
AT258		40	118,000	
AT259		40	60,300	
AT260		40	54,600	
AT249		30	810,500	
AT261		30	270,500	

Table LXII - Continued

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT262		30	623,350	
AT263		30	390,750	
AT264	Alcoa	30	471,150	
AT268	Quarter-Thickness	27	[illegible] 939,300	
AT269	Longitudinal	27	[illegible] 059 050	
AT270	(Continued)	27	2,[illegible]	
AT271		27	2,1[illegible]	
AT251		25	4,489[illegible]	
AT267		25	10,396,[illegible]	No Failure
AT266		23	16,779,400	No Failure
AT250		20	10,117,450	No Failure
AT376		60	3,400	
AT373		50	12,850	
AT379		50	15,300	
AT380		50	17,400	
AT381		50	16,100	
AT382		50	16,400	
AT377		40	64,700	
AT383		40	76,400	
AT384		40	63,600	
AT385	Alcoa	40	62,600	
AT386	Mid-Thickness	40	66,550	
AT374	Longitudinal	30	496,950	
AT387		30	661,050	
AT388		30	393,550	
AT389		30	469,000	
AT390		30	693,950	
AT393		27	2,754,000	
AT394		27	1,209,800	
AT395		27	1,803,100	
AT378		25	2,948,100	
AT392		25	15,608,950	No Failure
AT391		23	10,053,950	No Failure
AT375		20	10,012,250	No Failure

Table LXII - Continued

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT372		55	7,500	
AT378		50	15,800	
AT370		50	22,400	
AT371	Kaiser	40	103,800	
AT373	Mid-Thickness	40	82,700	
AT379	Longitudinal	40	89,600	
AT380			(1)	
AT381		35	211,800	
AT374		30	805,700	
AT375		30	1,070,700	
AT377		27.5	3,749,800	
AT376		25.0	10,226,500	No Failure
AT249		60	4,400	
AT247		50	15,100	
AT251	Kaiser	50	14,200	
AT252	Surface	50	15,000	
AT253	Longitudinal	40	81,000	
AT254		40	95,400	
AT255		40	87,500	
AT250		30	932,200	
AT256		30	604,900	
AT257		30	762,300	
AT248			(2)	
AT258		25	8,301,900	

(1) Equipment malfunction.

(2) Bent specimen.

TABLE LXIII

ROTATING BEAM FATIGUE PROPERTIES, R = -1.0, OF 2618 ALUMINUM ALLOY AT 250°F AND 400°F FROM SURFACE OF 4" x 8" BILLET, LONGITUDINAL DIRECTION

Unnotched Specimens
Billet (b)

Specimen	Supplier and Billet Location	Test Temp (°F)	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT127			60	3,700	
AT146			55	6,500	
AT126			50	10,700	
AT128			50	10,800	
AT129			50	15,900	
AT130			50	11,300	
AT131	Alcoa		50	15,300	
AT125	Surface		40	59,700	
AT132	Longitudinal	250	40	69,200	
AT133			40	53,400	
AT134			40	66,900	
AT135			40	60,800	
AT141			35	162,400	
AT142			35	199,500	
AT143			35	155,500	
AT144			35	182,900	
AT145			35	156,800	
AT122			30	395,300	
AT136			30	389,700	
AT137			30	406,100	
AT138			30	307,900	
AT139			30	336,800	
AT140			20	21,077,400	Did not fail
AT123			20	9,517,900	
AT124			15	14,510,200	Did not fail
AT147			50	7,400	
AT163			45	16,600	
AT148			40	27,400	
AT153			40	22,300	
AT154			40	38,200	
AT152			40	28,800	
AT169	Alcoa		40	28,400	
AT159	Surface		35	89,200	
AT166	Longitudinal	400	35	70,900	
AT167			35	89,500	
AT168			35	60,700	
AT171			35	60,000	

Table LXIII - Continued

Specimen	Supplier and Billet Location	Test Temp (°F)	Maximum Stress (KSI)	Cycles to Failure	Remarks
AT149			30	170,900	
AT155			30	236,300	
AT156			30	166,800	
AT157			30	144,000	
AT158	Alcoa		30	215,100	
AT162	Surface	400	25	910,100	
AT164	Longitudinal		25	1,113,800	
AT165	(Continued)		25	1,049,200	
AT150			20	4,092,600	
AT160			20	3,352,600	
AT170			20	3,849,600	
AT161			17	10,275,200	Did not fail
AT151			15	23,551,600	Did not fail
AT267			50	11,400	
AT270			45	18,400	
AT259			40	36,900	
AT260			40	71,700	
AT261	Kaiser		40	58,900	
AT269	Surface	400	35	157,600	
AT262	Longitudinal		30	344,200	
AT263			30	209,600	
AT266			30	292,200	
AT264			20	6,664,400	
AT265			18	6,616,200	
AT268			16	10,081,500	

Table LXIV

ROTATING BEAM FATIGUE PROPERTIES, R=-1.0, OF 2618 ALUMINUM ALLOY AT ROOM TEMPERATURE FROM SURFACE AND MID-THICKNESS OF 4" x 8" BILLET
LONGITUDINAL DIRECTION
Notched Specimens, K_t=2.4
Billet (b)

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
ATS181		60	500	
ATS177		50	800	
ATS178		50	1,100	
ATS179		50	1,150	
ATS180		50	1,400	
ATS173	Alcoa	50	1,400	
ATS182	Surface	40	5,150	
ATS183	Longitudinal	40	5,050	
ATS184		40	4,300	
ATS185		40	4,450	
ATS186		40	5,375	
ATS187		40	5,400	
ATS188		40	4,100	
ATS174		30	19,900	
ATS189		30	22,500	
ATS190		30	18,500	
ATS191		30	19,700	
ATS194		30	26,900	
ATS195		30	29,600	
ATS196		25	81,200	
ATS175		20	201,600	
ATS176		20	199,650	
ATS192		10	4,124,500	
ATS193		8	14,300,000	No Failure
ATM172		50	1,450	
ATM190		45	3,500	
ATM173		40	4,650	
ATM178		40	4,500	
ATM179		40	4,400	
ATM180		40	4,500	
ATM189	Alcoa	40	5,000	
ATM195	Mid-Thickness	35	12,600	
ATM196	Longitudinal	35	11,000	
ATM174		30	33,400	
ATM181		30	37,100	

Table LXIV - Continued

Specimen	Supplier and Billet Location	Maximum Stress (KSI)	Cycles to Failure	Remarks
ATM182		30	29,000	
ATM183		30	35,000	
ATM188		30	27,700	
ATM192	Alcoa	25	78,100	
ATM193	Mid-Thickness	25	103,800	
ATM194	Longitudinal	25	123,000	
ATM175	(Continued)	20	300,000	
ATM134		20	273,000	
ATM185		20	232,000	
ATM186		20	246,000	
ATM187		20	249,800	
ATM176		15	1,151,200	
ATM191		15	1,680,100	
ATM177		12.5	10,096,300	No Failure

Table LXV

ROTATING BEAM FATIGUE PROPERTIES, R = -1.0, OF 2618 ALUMINUM ALLOY AT 250°F AND 400°F FROM SURFACE OF 4" x 8" ALCOA BILLET, LONGITUDINAL DIRECTION, NOTCHED SPECIMENS, K_t = 2.4

Billet (b)

Specimen	Supplier and Billet Location	Test Temp. (°F)	Maximum Stress (Ksi)	Cycles To Failure	Remarks
AT 218	Alcoa Surface Longitudinal	250	45	3,000	
AT 219			40	4,700	
AT 197			40	6,100	
AT 203			35	11,000	
AT 206			35	12,500	
AT 207			35	9,500	
AT 208			35	10,000	
AT 204			30	25,000	
AT 220			30	27,000	
AT 209			25	70,700	
AT 210			25	66,300	
AT 211			25	60,000	
AT 205			25	69,700	
AT 198			20	253,400	
AT 212			20	185,200	
AT 213			20	230,000	
AT 199			15	1,005,800	
AT 221			15	689,600	
AT 200			12.5	1,175,400	
AT 201			10	1,328,700	
AT 214			10	2,097,200	
AT 215			10	4,972,900	
AT 202			8	2,371,100	
AT 216			8	3,533,700	
AT 217			6	13,418,100	No Failure
AT 420	Alcoa Surface Longitudinal	400	45	1,900	
AT 397			40	4,500	
AT 416			40	4,900	
AT 419			35	8,000	
AT 421			35	10,500	
AT 398			30	17,800	
AT 407			30	16,700	
AT 408			30	13,600	
AT 401			30	23,500	
AT 411			25	36,600	
AT 412			25	35,600	

Table LXV (Continued)

Specimen	Supplier and Billet Location	Test Temp.(°F)	Maximum Stress (Ksi)	Cycles To Failure	Remarks
AT 415			25	40,500	
AT 417			25	43,700	
AT 399			20	163,200	
AT 400			20	161,200	
AT 409			20	134,000	
AT 410	Alcoa		20	130,900	
AT 402	Surface		15	413,700	
AT 404	Longitudinal	400	15	636,300	
AT 414			15	524,900	
AT 418			15	405,600	
AT 403			10	4,681,400	
AT 406			10	5,444,500	
AT 413			8	18,910,500	
AT 405			8	24,316,300	No Failure

Table LXVI

CREEP-RUPTURE PROPERTIES OF 2618 ALUMINUM ALLOY AT 250°F FROM MID-THICKNESS OF 3" X 6½" BILLET, LONGITUDINAL DIRECTION

Billet (a)

Specimen		Alcoa Billet				Kaiser Billet			
		AT4C	AT3C	AT1C	AT2C	AT12C	AT11C	AT9C	AT10C
Applied Stress (KSI)		53	(1)	50	47	53	52	50	47
% Strain on Loading		1.00		.678	.607	1.64	1.18	1.07	.714
Time to Reach Indicated Creep Strain (Hrs.)	.05%	.01		.17	2.5	.01	.01	.03	9.4
	.10%	.07		1.5	59.0	.02	.02	.04	190
	.50%	1.0		501	-	.05	.30	165	-
	1.0%	1.7		793	-	.50	4.0	389	-
% Creep Strain After Indicated Time	1	.821		.089	.036	1.38	.514	.214	.036
	10	2.57		.168	.086	2.89	1.18	.321	.061
	100	-		.232	.135	3.71	1.35	.386	.085
	1000	-		2.68	.375	-	-	-	.179
Hours to Failure		11.7		1018	NF	121	243	796	NF
% Creep Strain at Failure		5.14		3.29	(2)	5.51	5.68	6.04	(2)

(1) Inadvertently overloaded during test setup.
(2) Specimen did not fail, test terminated after 1000 hours.

Table LXVII

CREEP-RUPTURE PROPERTIES OF 2618 ALUMINUM ALLOY
AT 250°F FROM MID-THICKNESS OF 4" x 8" ALCOA BILLET,
LONGITUDINAL DIRECTION

Billet (b)

Specimen		Alcoa Billet									
		AT25C	AT24C	AT30C	AT23C	AT29C	AT28C	AT27C	AT26C	AT22C	AT17C
Applied Stress (KSI)		55.0	53.0	52.0	50.0	51.0	(1)	49.0	48.0	45.0	40.0
% Strain on Loading		1.0	2.3	1.29	1.18	1.39	-	1.18	1.05	.52	.47
Time to Reach Indicated Creep Strain (Hrs)	.05%	.02	.01	.05	<.01	.01	-	.03	.08	9.5	168
	.10%	.03	.03	.06	.01	.03	-	.07	.11	-	-
	.50%	.07	.11	.30	6.5	.40	-	46	367	-	-
	1.0%	.08	.41	1.8	149.6	5.5	-	679	441	-	-
% Creep Strain After Indicated Time	1	5.85	1.32	.785	.439	.621	-	.407	.150	.041	.009
	10	-	2.19	2.11	.507	1.01	-	.429	.236	.049	.030
	100	-	-	3.21	.707	1.03	-	.492	.300	.066	.041
	1000	-	-	-	-	-	-	-	-	.088	.096
Hours to Failure		1.3	49.6	119.8	170	364	-	734	830	NF	NF
% Creep Strain at Failure		9.40	5.30	3.75	1.86	2.46	-	2.14	3.15	(2)	(2)

(1) Extensometer system malfunction, test discontinued.

(2) Specimen did not fail, test terminated after 1000 hours.

Table LXVIII

CREEP-RUPTURE PROPERTIES OF 2618 ALUMINUM ALLOY
AT 250°F FROM MID-THICKNESS OF 4" x 8" KAISER BILLET,
LONGITUDINAL DIRECTION

Billet (b)

Specimen		Kaiser Billet			
		AT53C	AT54C	AT51C	AT52C
Applied Stress (KSI)		53	51.5	50	47
% Strain on Loading		1.58	1.18	.857	.621
Time to Reach Indicated Creep Strain (Hrs.)	.05%	.05	.03	.40	.17
	.10%	.07	.04	1.0	.34
	.50%	.25	.21	218	280
	1.0%	.91	4.0	428	447
% Creep Strain After Indicated Time	1	1.04	.707	.107	.107
	10	5.59	1.39	.193	.214
	100	-	-	.385	.343
	1000	-	-	-	-
Hours to Failure		10.2	[illegible].7	753	891
% Creep Strain at Failure		5.77	2.08	5.25	5.38

Table LXIX

CREEP-RUPTURE PROPERTIES OF 2618 ALUMINUM ALLOY AT 250°F FROM MID-THICKNESS OF 8" x 11" BILLET, LONGITUDINAL DIRECTION

Billet (c)

Specimen		Alcoa Billet				Kaiser Billet			
		AT58C	AT57C	AT55C	AT56C	AT65C	AT66C	AT63C	AT64C
Applied Stress (KSI)		54	52	50	47	52	51	50	47
% Strain on Loading		3.50	2.57	1.71	.922	1.54	1.18	1.04	.754
Time to Reach Indicated Creep Strain (Hrs)	.05%	.01	.03	.03	.17	.03	.01	.03	1.0
	.10%	.02	.04	.04	.34	.04	.02	.04	21.8
	.50%	.03	.08	.25	810	.33	24	107	-
	1.0%	.13	.28	3.0	-	1.3	32.5	181	-
% Creep Strain After Indicated Time	1	2.9	1.61	.750	.150	.893	.243	.268	.050
	10	-	2.28	1.01	.235	1.95	.300	.400	.086
	100	-	-	1.24	.235	-	1.36	.486	.111
	1000	-	-	-	.857	-	-	-	.264
Hours to Failure		3.1	55.4	181	NF	31.0	175	300	NF
% Creep Strain at Failure		13.2	5.41	3.75	(1)	7.04	4.5	3.46	(1)

(1) Specimen did not fail, test terminated after 1000 hours.

Table LXX

CREEP-RUPTURE PROPERTIES OF 2618 ALUMINUM ALLOY AT 325°F FROM MID-THICKNESS OF 4" x 8" ALCOA BILLET, LONGITUDINAL DIRECTION

Billet (b)

Specimen		Alcoa Billet									
		AT34C	AT33C	AT32C	AT31C	AT38C	AT37C	AT22C	AT35C	AT18C	AT36C
Applied Stress (KSI)		50	48	45	45	44	42	40	38	35	33
% Strain on Loading		4.5	1.41	.78	.70	.66	.75	.55	.49	.375	.33
Time to Reach Indicated Creep Strain (Hrs)	.05%	.02	.01	.03	.05	.03	.17	142	23.0	536	291
	.10%	.03	.02	.05	.08	.10	26.0	196	100	704	998
	.50%	.04	.13	26.0	23.2	4.8	66.5	230	244	918	-
	1.0%	.08	4.8	35.5	36.6	9.3	72.0	235	265	999	-
% Creep Strain After Indicated Time	1	-	.743	.321	.368	.214	.064	.021	.007	.015	.000
	10	-	-	.382	.411	1.09	.064	.032	.046	.015	.000
	100	-	-	-	-	-	-	.032	.100	.015	.007
	1000	-	-	-	-	-	-	-	-	1.02	.101
Hours to Failure		.30	8.1	41.2	41.1	12.5	74.7	236	276	1050	NF
% Creep Strain at Failure		3.94	(2) 1.98	2.07	2.67	3.87	2.94	1.49	2.92	3.33	(1)

(1) Specimen did not fail, test terminated after 1000 hours.

(2) Chart deformation pen pegged at 7.6 hours, indicated strain is for 7.6 hours not 8.1 hours.

Table LXXI

CREEP-RUPTURE PROPERTIES OF 2618 ALUMINUM ALLOY AT 400°F FROM MID-THICKNESS OF 3" x 6½" BILLET, LONGITUDINAL DIRECTION

Billet (a)

Specimen		Alcoa Billet				Kaiser Billet			
		AT8C	AT5C	AT6C	AT7C	AT16C	AT13C	AT14C	AT15C
Applied Stress (KSI)		32	28	25	22	32	28	25	22
% Strain on Loading		.357	.357	.369	.354	.572	.357	.307	.268
Time to Reach Indicated Creep Strain (Hrs)	.05%	7.0	7.0	4.0	74.0	2.0	13.0	5.3	27.0
	.10%	11.0	14.0	29.0	256	4.7	22.0	19.0	104
	.50%	14.5	39.5	243	846	11.4	50.4	45.5	552
	1.0%	16.0	47.5	320	965	13.2	59.9	54.0	750
% Creep Strain After Indicated Time	1	.029	.036	.030	.006	.028	.000	.014	.000
	10	.100	.075	.064	.026	.321	.036	.054	.021
	100	-	-	.146	.062	-	-	-	.096
	1000	-	-	-	.190	-	-	-	.414
Hours to Failure		17.4	51.6	358	998	15.9	71.8	68.9	1037
% Creep Strain at Failure		4.93	4.69	4.03	3.26	1.93	3.30	3.34	8.27

Table LXXII

CREEP-RUPTURE PROPERTIES OF 2618 ALUMINUM ALLOY AT 400°F FROM MID-THICKNESS OF 4" x 8" ALCOA BILLET, LONGITUDINAL DIRECTION

Billet (b)

Specimen		Alcoa Billet									
		AT40C	AT39C	AT45C	AT19C	AT41C	AT20C	AT42C	AT46C	AT43C	AT44C
Applied Stress (KSI)		40	35	32	30	28	25	23	22	20	18
% Strain on Loading		.714	.535	.396	.311	.367	.330	.250	.246	.232	.236
Time to Reach Indicated Creep Strain (Hrs)	.05%	.01	.33	8.0	5.5	9.0	7.0	127	164	63.0	-
	.10%	.02	.90	14.5	10.0	17.0	19.0	221	480	190	-
	.50%	.03	1.8	25.0	18.5	27.7	368	294	-	-	-
	1.0%	.05	2.3	27.6	22.3	32.6	474	690	-	-	-
% Creep Strain After Indicated Time	1	-	.107	.021	.019	.007	.021	.000	.036	.011	.000
	10	-	-	.064	.10	.061	.064	.018	.036	.029	.011
	100	-	-	-	-	-	.107	.043	.039	.086	.011
	1000	-	-	-	-	-	-	-	.164	.179	.021
Hours to Failure		.10	2.6	30.1	27.8	37.3	586	757	NF	NF	NF
% Creep Strain at Failure		4.10	2.80	2.00	(1)	(1)	5.27	3.18	(2)	(2)	(2)

(1) Chart deformation pen pegged shortly after reaching 1% creep; consequently creep strain at failure was not obtained.

(2) Specimen did not fail, test terminated after 1000 hours.

Table LXXXIII

CREEP-RUPTURE PROPERTIES OF 2618 ALUMINUM ALLOY AT 400°F FROM MID-THICKNESS OF 4" x 8" KAISER BILLET, LONGITUDINAL DIRECTION

Billet (b)

Specimen		Kaiser Billet			
		AT50C	AT48C	AT47C	AT49C
Applied Stress (KSI)		30	28	25	22
% Strain on Loading		.471	.392	.321	.232
Time to Reach Indicated Creep Strain (Hrs)	.05%	3.6	7.0	8.3	18.1
	.10%	12.4	15.0	23.5	282
	.50%	288	34.7	106	1051
	1.0%	33.9	42.0	144	-
% Creep Strain After Indicated Time	1	.028	.001	.018	.043
	10	.086	.068	.069	.043
	100	-	-	.446	.079
	1000	-	-	-	.443
Hours to Failure		36.4	51.9	165	NF
% Creep Strain at Failure		1.89	3.92	3.25	(1)

(1) Specimen did not fail, test terminated.

Table LXXIV

CREEP-RUPTURE PROPERTIES OF 2618 ALUMINUM ALLOY AT 400°F FROM MID-THICKNESS OF 8" x 11" BILLET, LONGITUDINAL DIRECTION

Billet (c)

Specimen		Alcoa Billet				Kaiser Billet			
		AT59C	AT61C	AT60C	AT62C	AT70C	AT67C	AT68C	AT69C
Applied Stress (KSI)		28	28	25	22	32	28	25	22
% Strain on Loading		.519	.396	.375	.424	.321	.385	.394	.282
Time to Reach Indicated Creep Strain (Hrs)	.05%	11.0	13.0	97.5	286	6.7	4.0	17.1	19.9
	.10%	13.0	28.5	119	577	7.5	11.0	46.0	46.0
	.50%	17.5	80.5	171	868	9.9	31.3	83.5	180
	1.0%	20.3	95.7	202	992	10.9	37.5	101	252
% Creep Strain After Indicated Time	1	.000	.019	.000	.000	.007	.021	.034	.011
	10	.032	.041	.006	.000	.507	.090	.039	.025
	100	-	1.23	.054	.030	-	-	.964	.200
	1000	-	-	-	1.01	-	-	-	-
Hours to Failure		22.5	138	222	1019	12.1	45.8	127	398
% Creep Strain at Failure		1.39	(1)	3.50	3.57	3.36	3.62	5.32	5.62

(1) Chart deformation pen pegged after reaching 1% creep; consequently, creep strain at failure not obtained.

Appendix B

Tabulated Data From the Literature

Table LXXV

TENSILE PROPERTIES AT ROOM TEMPERATURE OF 2618-T6 ALUMINUM ALLOY
DATA FURNISHED BY NORTH AMERICAN AVIATION, LOS ANGELES DIVISION (1)

Billet Size	Direction	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (% in 2 in.)
Billet I 4" x 6"	L	61.5	54.2	6.0
	L	63.0	56.5	7.0
	L	61.4	52.2	8.0
	L	62.2	52.4	9.0
	L	61.5	54.3	9.0
	LT	62.0	53.4	6.5
	LT	61.7	52.7	6.0
	LT	61.4	51.8	8.5
	LT	62.7	54.0	7.0
	LT	60.3	51.7	6.0
	LT	60.0	51.2	6.0
	ST	62.0	53.5	6.0
	ST	60.6	52.4	5.5
	ST	61.5	53.4	6.5
Billet II 4" x 6"	L	61.6	53.0	6.5
	L	62.8	55.3	8.0
	L	62.6	53.8	9.5
	L	61.7	53.7	9.0
	L	62.7	53.7	10.0
	L	61.9	53.2	5.0
	L	62.6	57.1	7.0
	LT	62.2	54.1	4.0
	LT	63.5	51.6	6.5
	ST	59.7	53.5	3.0
	ST	59.5	53.3	3.5
	ST	61.9	53.7	4.5
	ST	61.0	53.7	3.5
Billet III 6" x 8"	L	60.5	51.2	6.0
	L	58.1	48.8	6.0
	L	54.0	44.3	6.5
	LT	59.4	51.6	6.0
	LT	61.4	52.7	7.0

(1) Data from Reference (3) report

Table LXXVI

TENSILE PROPERTIES OF 2618-T6 ALUMINUM ALLOY
AT 400°F AFTER EXPOSURE AT 400°F FOR 100 HOURS
DATA FURNISHED BY NORTH AMERICAN AVIATION, LOS ANGELES DIVISION (1)

Billet Size	Direction	Ultimate Strength (KSI)	Yield Strength (KSI)	Elongation (% in 2 in.)
Billet I 4" x 6"	L	37.3	33.8	13.0
	L	37.3	33.9	18.0
	LT	36.8	33.5	13.0
	LT	37.2	33.6	19.0
Billet II 4" x 6"	L	38.8	35.8	12.0
	L	37.5	--	16.0
	L	37.7	34.4	13.0
	LT	38.7	35.8	13.0
	ST	37.5	33.9	14.0
	ST	37.5	33.8	14.0
	ST	37.0	33.6	14.0
	ST	38.0	34.8	9.0
	ST	38.4	35.4	10.0

(1) Data from Reference (3) report

Table LXXVII

COMPRESSIVE PROPERTIES OF 2618-T6 ALUMINUM ALLOY
AT ROOM TEMPERATURE AND AT 400°F AFTER EXPOSURE AT 400°F
FOR 100 HOURS
DATA FURNISHED BY NORTH AMERICAN AVIATION, LOS ANGELES DIVISION (1)

Billet Size	Test Temp. (°F)	Direction	Yield Strength (KSI)
Billet I 4" x 6"	RT	LT	54.5
	RT	ST	54.9
	RT	ST	55.3
	RT	ST	54.7
Billet II 4" x 6"	RT	L	55.9
	RT	L	54.5
	RT	L	57.1
	RT	LT	57.6
	RT	LT	57.2
	RT	ST	57.2
Billet I 4" x 6"	400	L	36.0
	400	LT	34.6
	400	ST	34.8
	400	ST	34.7
	400	ST	34.7
Billet II 4" x 6"	400	L	35.5
	400	L	34.9
	400	L	35.3
	400	LT	35.9
	400	LT	35.6

(1) Data from Reference (3) report

Table LXXVIII

SHEAR PROPERTIES OF 2618-T6 ALUMINUM ALLOY
AT ROOM TEMPERATURE AND AT 400°F AFTER EXPOSURE AT 400°F FOR 100 HOURS
DATA FURNISHED BY NORTH AMERICAN AVIATION, LOS ANGELES, DIVISION (1)

Billet Size	Test Temp. (°F)	Direction	Ultimate Shear (KSI)
Billet I 4" x 6"	RT	L	41.0
	RT	L	42.1
	RT	LT	42.4
	RT	LT	42.0
	RT	LT	42.2
	RT	ST	43.0
	RT	ST	42.7
	RT	ST	42.5
Billet II 4" x 6"	RT	L	42.0
	RT	L	42.0
Billet I 4" x 6"	400	L	24.0
	400	L	24.1
	400	LT	24.1
	400	LT	23.6
	400	LT	23.9
	400	ST	23.4
Billet II 4" x 6"	400	L	24.9
	400	L	24.7
	400	ST	24.6

(1) Data from Reference (3) report

Table LXXIX

BEARING PROPERTIES, e/D = 2.0 OF 2618-T6 ALUMINUM ALLOY
AT ROOM TEMPERATURE AND AT 400°F AFTER EXPOSURE AT 400°F FOR 100 HOURS
DATA FURNISHED BY NORTH AMERICAN AVIATION, LOS ANGELES DIVISION (1)

Billet Size	Test Temp. (°F)	Direction	Ultimate Strength (KSI)	Yield Strength (KSI)
Billet I 4" x 6"	RT	L	118.7	99.2
	RT	L	117.7	95.5
	RT	LT	111.6	--
	RT	LT	115.5	92.0
Billet II 4" x 6"	RT	L	115.9	96.8
	RT	L	118.6	93.0
	RT	ST	117.4	95.7
	RT	ST	115.2	92.9
	RT	ST	114.1	92.9
Billet I 4" x 6"	400	L	73.6	58.2
	400	L	75.3	59.8
	400	LT	74.2	59.1
	400	LT	75.8	61.9
Billet II 4" x 6"	400	L	77.9	59.0
	400	L	77.7	61.8

(1) Data from Reference (3) report

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13. ABSTRACT Mechanical property tests were conducted over the temperature range from room temperature to 400°F on three sizes of hand forged 2618 aluminum alloy billet produced by two suppliers. Tension, notched tension, tension thermal stability, compression, shear, bearing, fracture toughness, creep, axial and rotating beam fatigue, and stress corrosion properties were determined. Tension, compression, shear and bearing properties were statistically analyzed to determine values similar to "A" and "B" design values found in MIL-HDBK-5.

Alloy 2618-T61 retains its static and fatigue properties well at elevated temperatures and has good resistance to creep deformation. At 400°F 2618 retains approximately 80% of its room temperature properties after short time exposure. Applied stresses exceeding the yield strength are required for appreciable creep to occur at 250°F, while stresses of approximately 75 and 50 percent of the yield strength at temperature are required for 1% creep to occur in 1000 hours at 325°F and 400°F. Plane strain fracture toughness at all areas in the billet in the longitudinal direction was similar to 7075-T6; however, the quarter-thickness and surface areas of the billet in the long transverse direction generally had lower fracture toughness than most data reported for 7075-T6. Stress corrosion tests indicated that 2618 is susceptible to stress corrosion cracking in the two transverse directions when stressed to 75% of its yield strength.

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